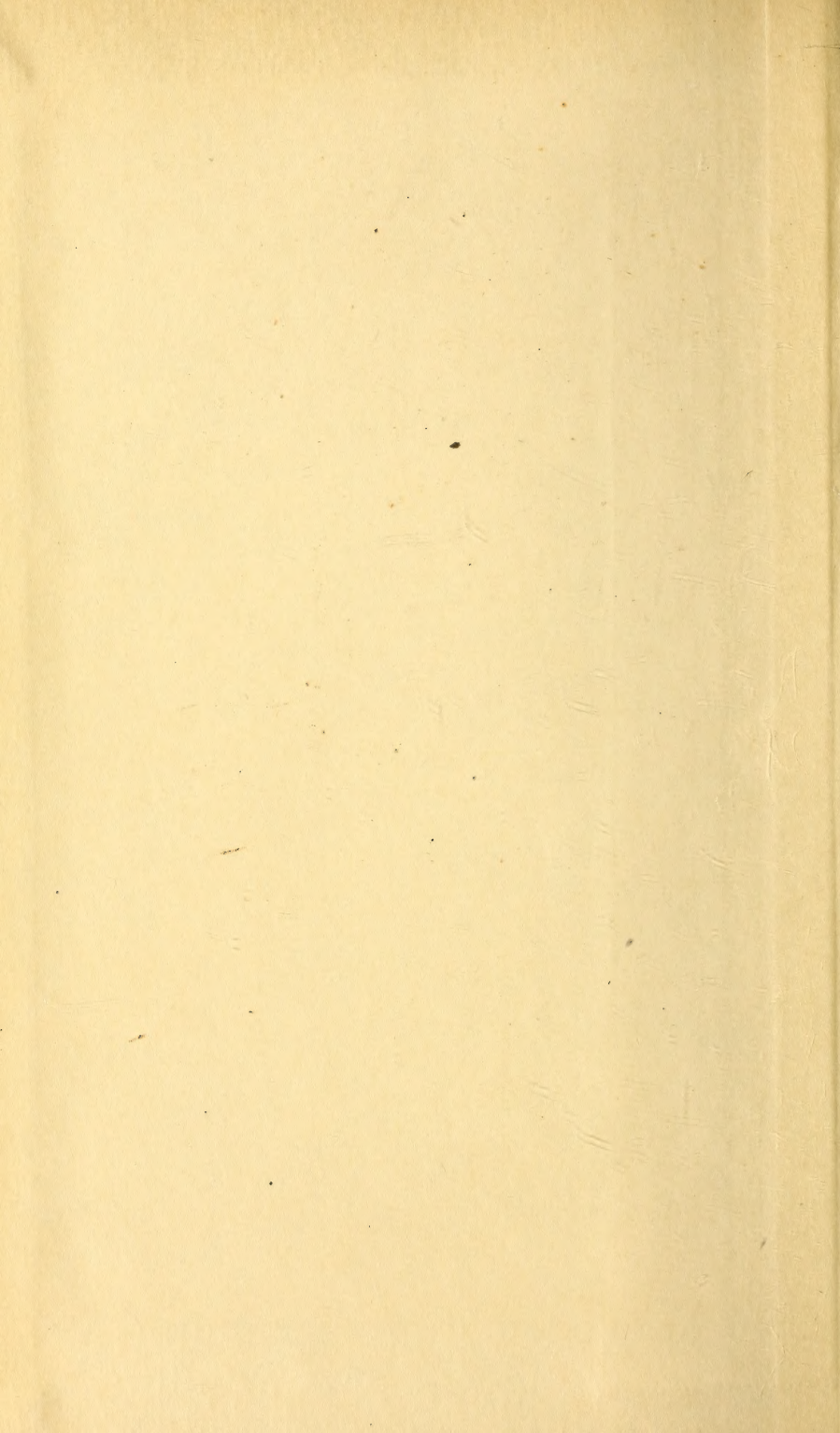
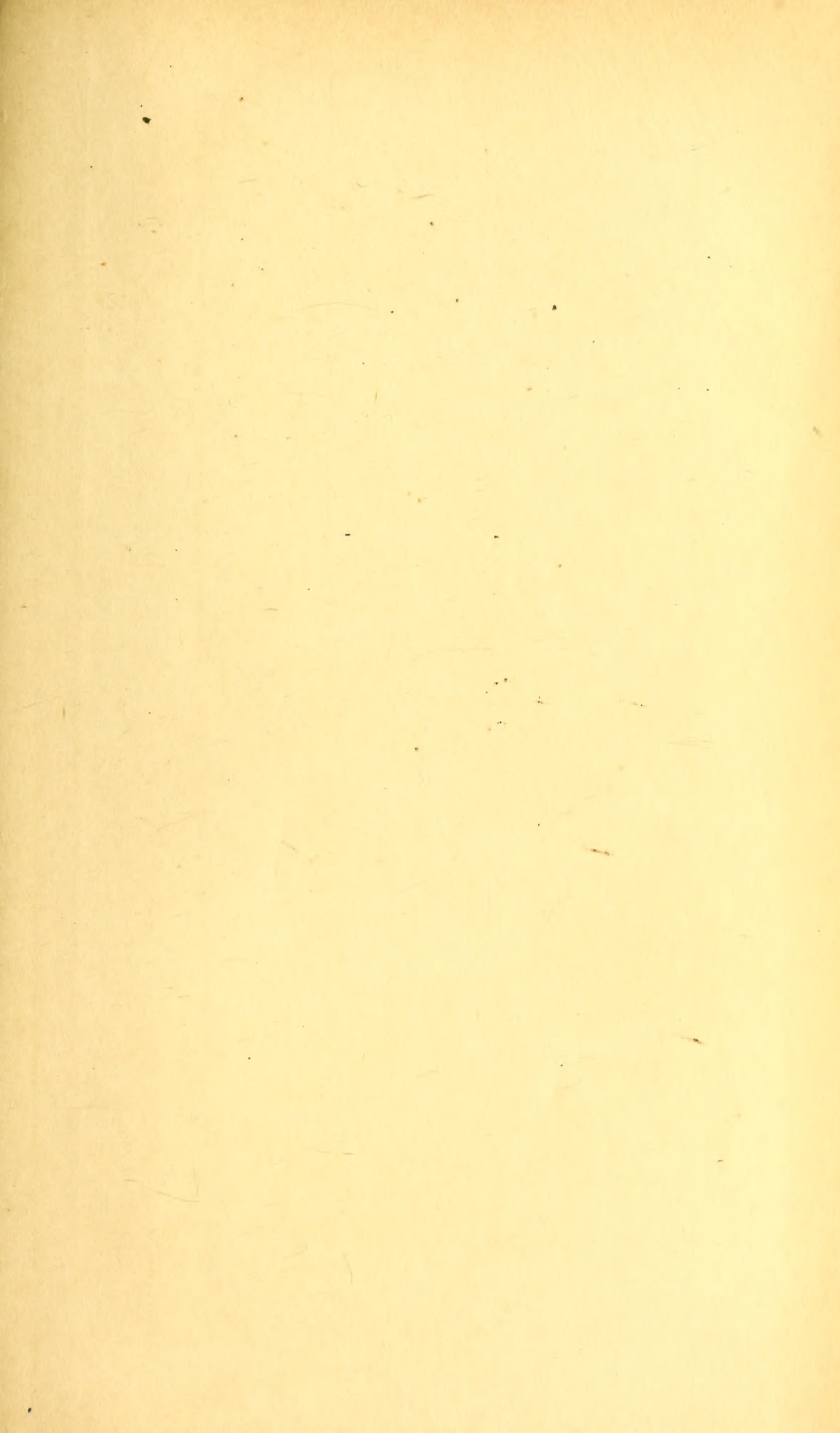


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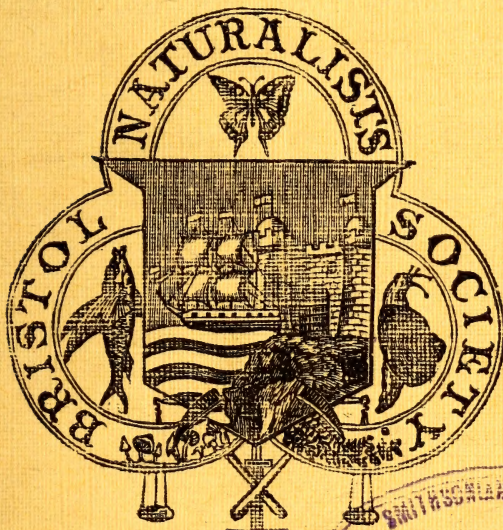
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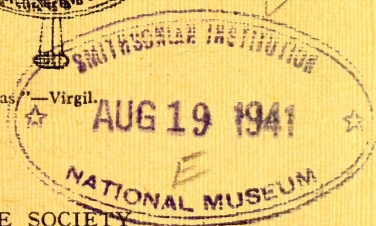
Bristol Naturalists' Society

EDITED BY H. W. TURNER, M.A., F.G.S.

ASSISTED BY A COMMITTEE



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	St. John, Miss E., M.A. ..	19 Down Cote View, Bristol, 9	<i>Bi.</i>
A.	Salmond, P. W.....	22 Tyndall's Park Road, Clifton, Bristol, 8	<i>F.G.</i>

	Salter, Miss Joan E. R., B.A.	47 Well Lane, Horsell, Woking	<i>B.</i>
A.	Sampson, Miss A. M.	Bristol Road, Congresbury, near Bristol	<i>Bi.</i>
*	Sandwith, Mrs.	26 Canynge Square, Clifton, Bristol, 8	<i>B.E.</i>
A.	Saunders, Miss C. E.	25 Robertson Road, Eastville, Bristol, 5	<i>Bi.</i>
	Savory, J. H.	WindyrIDGE, Abbots Leigh, near Bristol	<i>O.</i>
+	Scase, R. P.	Lower Northend Farm, Batheaston, Bath.	<i>B.</i>
*	Shaw, Miss T.	12c Kingsdown Parade, Bristol, 6	<i>B.F.G.</i>
	Shearer, Miss O. M.	15 Abbotsford Road, Redland, Bristol, 6	<i>F.O.</i>
A.	Shield, Miss M., B.Sc.	Brackenhurst, 6 Southmead Road, Filton, Bristol	<i>Bi.</i>
	Shilstone, H. C.	124 Victoria Avenue, Redfield, Bristol, 5	<i>F.G.</i>
J.	Simister, J. M. (1940)	4 Hillgrove, Henleaze, Bristol	<i>O.</i>
A.	Simmons, Miss L., L.R.A.M.	47 Grosvenor Road, St. Paul's, Bristol, 2	<i>F.O.</i>
*	Skene, Prof. Macgregor, D.Sc., F.L.S.	The University, Bristol, 8	<i>B.F.</i>
	Skene, Mrs.	36 Lawrence Grove, Westbury-on- Trym, Bristol	
	Smith, D. Munro, M.R.C.S., L.R.C.P.	Norfolk House, Overnhill Road, Downend, near Bristol	<i>B.O.</i>
A.	Smith, Miss M. de Lattre ..	The School House, High Ham, Taunton, Som.	<i>G.</i>
J.	Smith, P. G. Munro	Norfolk House, Overnhill Road, Downend, near Bristol	<i>B.O.</i>
*	Smith, Stanley, M.A., D.Sc., F.G.S.	The University, Bristol, 8	<i>G.</i>
A.	Stanhope, Rev. A. J.	"Jesmond," 182 Bishop Road, Bristol, 7	<i>F.G.</i>
A.	Stocqueler, Miss A. G. S. ..	8 Alma Vale Road, Clifton, Bristol, 8	<i>F.O.</i>
A.	Strudwick, Miss F. E., M.A.	26 Woodstock Road, Redland, Bristol, 6	<i>B.F.</i>
	Studer, J. P.	44 Clifton Park Road, Bristol, 8	<i>G.</i>
	Taylor, Miss M., D.Sc.	The University, Bristol, 8	<i>O.</i>
A.	Taylor, R. J.	12 Claremont Avenue, Bishops- ton, Bristol, 7	<i>F.</i>
	Taylor, W. R., M.A.	5 Pembroke Vale, Clifton, Bristol, 8	<i>O.</i>
*	Tetley, H., B.Sc., F.Z.S. ..	4 The Avenue, Sneyd Park, Bristol, 9	<i>E.O.</i>
	Tetley, Mrs.	4 The Avenue, Sneyd Park, Bristol, 9	<i>O.</i>
A.	Thomas, Richard	131 Cumberland Road, Redcliff, Bristol, 1	<i>G.</i>
*	Thompson, H. S., A.L.S., (decd., 1940)	22 West Mall, Clifton, Bristol, 8	<i>B.F.G.</i>
	Tovey, P. M.	12 Woodfield Road, Redland, Bristol, 6	<i>F.</i>
J.	Trenerry, G. G.	Windover, 54 Kellaway Avenue, Bristol, 6	<i>O.</i>
*	Trueman, Prof. A. E., D.Sc., F.R.S.E., F.G.S.	The University, Glasgow	<i>G.</i>
	Trueman, Mrs. A. E.	c/o The University, Glasgow	<i>G.</i>
	Tucker, B. W., M.A. M.B.O.U.	9 Marston Ferry Road, Oxford	<i>O.</i>
	Turner, H. W., M.A., F.G.S.	The University, Bristol, 8	<i>G.</i>
	Turner, Mrs. H. W.	Mortimer House, Clifton, Bristol, 8	
A.	Verhey, Miss D. E., B.Sc. ..	Stanmore House, Royal Crescent, Weston-super-Mare	<i>B.</i>

* Wallis, F. S., D.Sc., Ph.D.,	The Museum and Art Gallery, Bristol, 8	<i>F.G.</i>
A. Walsh, Miss C. L. B.	8 Alma Vale, Clifton, Bristol, 8	<i>F.</i>
Wareham, Miss F.	252 Charlton Road, Kingswood, Bristol	<i>O.</i>
Webb, H. M., B.Sc.	Redgarth, Church Road, Stoke Bishop, Bristol, 9	<i>G.O.</i>
Webb, Mrs. H. M.	Redgarth, Church Road, Stoke Bishop, Bristol, 9	<i>O.</i>
Webb, H. Vicars	58 Belmont Road, St. Andrew's, Bristol, 6	<i>F.O.</i>
Weir, Mrs.	Hursley Hill, Whitechurch, nr. Bristol	<i>O.</i>
J. Weir, D. A. (1940)	Hursley Hill, Whitechurch, nr. Bristol	<i>O.</i>
Weir, G. M. (1940)	Hursley Hill, Whitechurch, nr. Bristol	<i>O.</i>
* Welch, F. B. A., B.Sc., Ph.D., F.G.S.	H.M. Geological Survey, South Kensington, S.W.7.	<i>G.</i>
Wells, A. Kingsley, D.Sc., F.G.S. (1940)	25 Cooper Road, Westbury-on-Trym, Bristol	<i>G.</i>
Weston, F. J.	The Tynings, Chew Stoke, nr. Bristol	
A. Wheeler, Miss K. E.	Hillside, Watchet, Som.	<i>F.</i>
Whittard, Prof. W. F., D.Sc., Ph.D., F.G.S.	The University, Bristol, 8	<i>G.</i>
Williams, Mrs. (1940)	11 Vyvyan Terrace, Clifton, Bristol, 8	<i>F.</i>
Williams, Miss M. E.	2 Rockleaze Avenue, Stoke Bishop, Bristol, 9	<i>F.O.</i>
+ Wills, W. Melville	Bracken Hill, Leigh Woods, Bristol	
A. Woolls, Miss F. R. (re- signed, 1940)	14 Russell Grove, Westbury Park, Bristol, 6	<i>Bi.B.</i>
J. Yeatman, John	45 Downs Cote Road, Westbury-on- Trym, Bristol	<i>F.</i>
* Yonge, Prof. C. M., D.Sc...	The University, Bristol, 8	

* * * *

Honorary Members

- R. M. Prideaux, F.R.E.S., Brasted Chart, near Sevenoaks, Kent.
 Prof. H. S. Hele Shaw, M.I.C.E., LL.D., F.R.S., 64 Victoria Street, Westminster,
 S.W.1.
 Sir Ernest Cook, D.Sc., 40 Alma Road, Clifton, Bristol, 8.
 H. Womersley, F.R.E.S., A.L.S., 36 Wattle Street, Fullerton Estate, Adelaide,
 S. Australia.
 A. Selley (1940), 116, Coronation Road, Bristol, 3
 J. W. Tatcher M.Sc., (1940), 57 Berkeley Road, Bishopston, Bristol, 7.

REPORT OF COUNCIL

TO DECEMBER 31st

1939

YOUR Council reports with regret the loss by death during the year of the following four members: Dr. A. L. Flemming (Past-President), Messrs. W. Chamberlain, G. W. S. Hurst, and H. L. Sully.

At the Annual Meeting in January the officers were re-elected with the following exceptions: Mr. Croome Leach took the place of Prof. Yonge as Vice-President, and Mr. A. H. Peach succeeded Mr. F. W. Evens as Hon. Treasurer. On Council, Mrs. A. G. Bell, Mr. F. W. Evens, and Prof. Yonge, took the places of Mr. T. V. T. Baxter, Mr. Croome Leach, and Prof. Reynolds, as unofficial members.

We regret to report the necessity, on account of War conditions, to dissolve the Biological Teachers' Section.

During the year the additions by Miss Roper to White's *Flora* have been completed by Miss Strudwick, with the collaboration of Mr. Ivor Evans.

Mr. L. H. Matthews was appointed to make certain observations for the "Association for the study of Systematics in relation to General Biology."

It was decided in General Meeting to bestow Honorary Membership on Messrs. A. Selley and J. W. Tutchet for their respective services to science.

Mr. Tutchet's association with the Society dates from the period when its meetings were held in the rooms of the Philosophical Institution in Park Street (now the Freemasons' Hall), and he can well recollect his friendship with the first Secretary, Professor A. Leipner, and the first Treasurer, Mr. W. W. Stoddart.

Mr. Tutchet was elected a member of the Society in May, 1901, and since that date has been active in its interests not only with the parent society but with many of its sections, especially the Geological. He served as President during 1931 and 1932. In 1927 he was President of the Bristol Field Club, and in that capacity tactfully conducted the negotiations whereby the Club was eventually incorporated as a Field Section with the Bristol Naturalists' Society.

Mr. Tutchet has many publications in the *Proceedings*, amongst which may be mentioned a paper on the Lower Oolites near Bristol in 1903, the strata exposed in the Filton-Avonmouth Railway in 1908, and the Lias about Keynsham in 1923. In 1925, in collaboration with Professor A. E. Trueman, he published a paper in the *Quarterly Journal of the Geological Society of London* on the Liassic rocks of the Bristol District.

At all times Mr. Tutchet has been anxious to place his knowledge and collections at the disposal of others interested, and many members of the Society could testify to his unfailing courtesy and depth of knowledge. His acquaintance with bibliography is encyclopædic.

Mr. Selley joined the Society in 1925, and the Geological Section at an earlier date. He has been chiefly interested in the prehistoric archaeology of the Bristol District. For many years he tramped over Mendip, and collected thousands of flint implements left by earlier Neolithic man. Methodically, field by field, he

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searched areas that had been ploughed recently and exposed to the effect of rain and frost. The extensive collections at the Bristol Museum and Art Gallery bear witness to his careful and painstaking work and his discernment in such discoveries.

But Mr. Selley is also interested in all that deals with the early history of Bristol. He was largely responsible for the discovery of the Roman villa at Brislington—from which the pavement and other objects are in the Museum and Art Gallery. He also spent many weeks excavating the Roman remains on Portway—now preserved and in the custody of the city.

During the demolition of old property in the city, Mr. Selley was always present in case any objects of importance were brought to light.

Council would also wish to congratulate Mr. H. L. F. Audcent upon the distinction conferred upon him by the University of Bristol in granting him the degree of M.Sc. *honoris causa*.

The 12th Annual Dinner was held at the Royal Hotel, the retiring Headmaster of Clifton being the guest of honour.

The Summer Field Meeting was as usual arranged by the Field Section and was successfully held on Saturday, June 17th, under the leadership of Messrs. F. G. Hudson and G. E. J. McMurtrie, at Frocester and Nympsfield Hill.

F. STENHOUSE ROSS, *Hon. Secretary*.

The Hon. Treasurer in Account with the Bristol Naturalists' Society

Dr.

RECEIPTS AND PAYMENTS FOR THE YEAR ENDING 31st DECEMBER, 1939.

Cr.

1938 £ s. d.	To Members' Subscriptions :— Life Ordinary : 1937 " 1938 " 1939 " 1940 Associate : 1937 " 1938 " 1939 Junior : 1938 " 1939 " Sale of Publications " Biological Teachers' : received after Section disbanded Grants towards <i>Proceedings</i> Interest on Deposit	£ s. d.	£ s. d.	1938 £ s. d.	By Subscriptions :— Ray Society <i>Zoological Record</i> S. W. Naturalists' Union <i>Proceedings</i> , 1938 Stationery & Printing Postages, etc., Hon. Treasurer " Hon. Secretary " Hon. Editor Fire Insurance Meeting Expenses Deficit on Dinner Cheque Book Bank Charges Witherby's British Birds Librarian's Expenses Late Miss I. M. Roper Fund : <i>Journal of Botany</i> Subscriptions to Sections paid over Balance to next Account :— Cash at Bank Cash in hand, Hon. Sec.	£ s. d.	£ s. d.
60 15 0		5 0 0	.. .. .	4 19 0	.. .. .	4 15 0	
17 0 0		10 0 0	.. .. .	86 5 6	.. .. .	96 11 10	
12 6		1 0 0	.. .. .	18 7 9	.. .. .	11 17 4	
6 17 6		57 0 0	.. .. .	1 11 0	.. .. .	6 12 3	
22 0 0		10 0 0	.. .. .	11 2 2	.. .. .	1 10 0	
1 7 2		5 0 0	.. .. .	Cr. 2 0	.. .. .	5 18 4	
108 12 2		16 10 0	.. .. .	.. .. .	.. .. .	8 0 0	
26 11 0		2 6	.. .. .	.. .. .	.. .. .	5 0 0	
104 17 8		17 6	.. .. .	.. .. .	.. .. .	10 6 0	
240 0 10		1 0 0	.. .. .	8 1 5	.. .. .	1 1 0	
		5 12 6	.. .. .	8 10 6	.. .. .	129 9 3	
		1 4 0	.. .. .	138 15 4	.. .. .	28 8 6	
		115 5 0	.. .. .	26 11 0	.. .. .	56 14 7	
		28 8 6	.. .. .	.. .. .	.. .. .	3 15 8	
		74 14 6	.. .. .	74 14 6	.. .. .	60 10 3	
		74 14 6	.. .. .	240 0 10	.. .. .	£218 8 0	
		£218 8 0	.. .. .		.. .. .		

A. H. PEACH, *Hon. Treasurer*.
8th January, 1940.

Audited and found correct.

Ernest H. COOK, D.Sc.
CHAS. BARTLETT, F.C.A., } Auditors.

Bristol, 15th January, 1940.

LIBRARIAN'S REPORT

FOR THE YEAR 1939

THE inflow of scientific journals into the Library continues almost unabated, and notice has so far been received of the temporary suspension of only two periodicals—*Countryside* and the *Report of the Devon Bird-watching and Preservation Society*. Although there are no new exchanges to report, over eighty series of publications were received during 1939 in exchange for the *Proceedings* of the Society.

The Society is indebted to Mr. H. C. Shilstone, Mr. F. Stenhouse Ross and Mr. H. S. Thompson for the presentation of a number of books. The many gifts of Mr. Thompson include a complete set to date of an attractive quarterly, *The Tree Lover* (parts 1-29), and the subscription to this periodical for the year 1940.

As in the past, *Countryside*, the *Zoological Record*, and publications of the Ray Society were subscribed for. Volumes I-III of Wetherby's *British Birds* (to be completed in five volumes) have been purchased for the Library. Volume IV should have appeared last autumn but has been held up owing to the outbreak of war. By a coincidence, the publication of the previous edition of *British Birds* suffered a like fate at the beginning of the last war. Journals have been received as in previous years from the Geological, Entomological, Botanical and Ornithological Sections.

The number of books borrowed from the Library during 1939 was 150—a slight decrease in comparison with the previous year. The Borrowers' Book, introduced just over a year ago, appears to be a satisfactory method of recording the borrowing of books. A list of all periodicals entering the Library has been posted on the notice board and the number and part of each publication is entered as received. The names of recent additions by presentation or purchase are added as received to an adjoining list. The cupboards in the cellars behind the Library have been cleared and their contents sorted and listed. The work of cataloguing is progressing and it is hoped that by the time the next report is presented the catalogue will have been completed.

It has not been possible under the present unsettled conditions to have any binding done, and unbound periodicals are accumulating rapidly. It has been suggested that it might be possible for the Council to make an annual grant to the Library for binding and the purchase of up-to-date works on various subjects.

H. GORVETT, *Hon. Librarian.*

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REPORT OF BOTANICAL SECTION

1939

THE Section has met nine times during the year, no meetings being held in August, September and October. Since November, meetings have been held on Saturday afternoons instead of on Monday evenings.

The meetings have been given over chiefly to the discussion of botanica specimens brought by members. Several new records have been made this year, including *Salvia glutinosa* exhibited in January by Miss Fitzjohn, and *Draba muralis* from Hawkesbury Upton, shown at the March meeting by Mr. Evans.

Mrs. Boley gave a paper entitled "An ecological survey of Dundry Down" at the February meeting. The subject was introduced by a brief reference to the geography, geology and history of Dundry Hill and the division of the vegetation into three types of Plant Association—the Open Down, Wooded Quarry and Hazel Copse. The Open Down formed the specific subject of the paper. The paper was illustrated by lantern slides showing characteristic features.

At the April meeting Mrs. Bell showed twenty-six sheets of *Epilobium* including the hybrids *montanum* $\times$ *parviflorum* and *montanum* $\times$ *roseum* with their parents.

During the summer, the Section was again privileged to visit the University Gardens and see some of the Plant Breeding experiments under the leadership of Prof. M. Skene.

At the December meeting, members were shown over the new Botanical Buildings of the University.

It is with very great regret that we record the death of Mr. H. J. Gibbons, who was a member of the Society for over twenty years and, during most of that time, was a working member of the Section.

F. F. GLASSPOOL, *Hon. Secretary.*

REPORT OF ENTOMOLOGICAL SECTION

1939

10th Jan. 75th Annual Meeting. The President, Mr. J. W. Norgrove, and Hon. Secretary, Mr. C. Bartlett, were re-elected.

Mr. Bartlett gave notes upon his experiences with *Leucania L. album* which he had taken in S. Devon last September; specimens were exhibited also of a second brood reared from ova obtained.

The breeding of *Heliothis peltigera* and the occurrence of *Leucania vitellina* were also reported.

14th Feb. Meeting held at the University, and open to General Members. The President of the Society and nine General and eight Sectional Members attended. Mr. Bartlett read a paper upon "the Class Insecta with special reference to them as disease carriers." Mr. Pearman gave some notes upon *Psocidæ*, illustrated by drawings of their wings, venation and markings. Mr. Norgrove gave papers upon the occurrence of *Deilephila porcellus* at Kingsweston Down and *Limenitis sibylla* in the New Forest. Mr. Peach gave an account of a visit to Bala and Shropshire in search of *Coenonympha tullia*, illustrated by specimens of these two local races. Mr. Kromler exhibited a box of moths taken in Leigh Woods.

21st March. Mr. Bartlett contributed notes on "Hearing in Man and Animals," with special reference to insects.

18th April. Mr. Peach exhibited a section of his collection, especially of species of butterflies liable to variation, *Lysandra coridon*, *Polyommatus icarus*, *Pieris napi*, and *Euphydryas aurinia*, etc.

11th Nov. Mr. Kromler exhibited a specimen of *Deilephila euphorbiæ* bred from a larva found with others at Spurn Head in 1931 by Mr. J. Crowther. Mr. Bartlett read notes on the differences in locality and stages of *Lasiocampa quercus* and its var. *callunæ*, illustrated by bred specimens, including ab. *purpurascens* and *olivacea fasciana*; he also read an article on the capture of moths at night, by Dr. A. Russell Wallace, at Sarawak, from his work on "The Malay Archipelago," and his experience of favourable conditions corresponded with British experiences.

16th Dec. Exhibits: Mr. Peach, aberrations of *Lysandra coridon* taken this year; Mr. Bartlett, specimens of *Tanyptera arrata* and var. *ruficornis* (Dip.) taken near Tintern, flying round dead beech stumps.

The year closed with a membership of sixteen, the same as in 1938.

CHAS. BARTLETT, *Hon. Secretary.*

REPORT OF FIELD SECTION

1939

THE report of any activity or community for 1939 is of necessity coloured by events which culminated in the declaration of war early in September. The Field Section is no exception to this generalisation. Soon after the outbreak of war your officers cancelled all further meetings for the session chiefly on account of their inability to provide transport facilities.

At the Annual Meeting in January Mr. Ivor Evans succeeded Mr. H. F. Barke as President and Mr. F. W. Evens became Vice-President. Miss A. Morrison was elected to serve on the Committee in place of Mr. F. N. Reed. The membership now stands at 82, an increase of 3 upon that of 1938.

The Cotswold escarpment from Dursley to Chipping Sodbury was the area selected for examination, and your Committee wish to thank those who so kindly contributed notes on the district.

Mr. H. O. Edmonds was the leader of the May meeting, when Stinchcombe Hill and Uley were visited. Advantage was taken of the splendid view-point on Uley Bury to demonstrate the salient characteristics of the Cotswold Edge.

In June your Section solicited the ever-ready help of Mr. F. G. Hudson, President of the Cotswold Club, who, with Mr. G. E. J. McMurtrie and Miss M. D. Hiley acted as leaders for a meeting at Frocester and Nymphsfield. The church at Leonard Stanley was first visited, after which Selsley Common provided an excellent collecting ground both for the geologists and the botanists. Members visited the Nymphsfield Long Barrow and Hetty Pegler's Tump. Once again the fine extensive views over the River Severn were greatly appreciated by those present.

The third—and unfortunately the last—general meeting was held in the Hawkesbury Upton district in July, when Mr. H. F. Barke acted as leader. Members were met at the Hawkesbury xvth century church by the Rev. Devereux Mack, M.A., who kindly gave a description of this interesting building. After tea, and despite bad climatic conditions, a walk over varied country rewarded the botanists and geologists with much material.

Mr. Vicars Webb again arranged and completed a series of ornithological meetings and reports as follows :—

April 26th. Brockley Coombe. Chief observation was a large rookery; Blackbirds were the dominant songsters; others included Song Thrush, Robin, Wren, Great and Blue Tits.

May 6th. Oldbury Court Estate and Frenchay. Migrants in song included Blackcap, Willow Warbler and Chiff-chaff. A Greater Spotted Woodpecker was heard drumming.

May 17th. Blaise Woods. A few songsters included two migrants, Hedge Warbler and Blackbird. Green Woodpecker and Ring Dove were also heard. Tree foliage was at an impressive stage.

June 3rd. Blagdon Lake. The party was welcomed by Mr. Donald Carr. Chief observations :—a female Mallard with her family, pair of Tufted duck, Coot and Waterhens, Swifts and House Martins. Willow Warblers were in splendid voice and Whitethroats numerous.

The field meetings for observation in botany, again led by Mr. Ivor Evans, have been very successful. The following programme was carried out :—

22nd April—Keynsham and Chew Valley.

20th May—Cambridge Batch, Broadfield Down and Wurple Pool.

24th June—Thornbury district.

22nd July—Hursley Hill and Marksbury Vale.

29th July—Cromhall.

Your Committee is deeply indebted to all leaders for their help and continued interest ; without them such a section as this would cease to exist.

Although the outbreak of hostilities necessitated a cancellation of the remaining meetings, your Committee are of opinion that the activities of the Field Section are of even more value in war-time than in peace time. They therefore hope that it will be possible to continue the policy of the last few years although of necessity in a modified form.

M. DORIS HILEY, *Hon. Secretary.*

REPORT OF GEOLOGICAL SECTION

1939

THE Annual Meeting was held on January 20th, 1939, at 7.15, Professor W. F. Whittard in the chair.

Professor Whittard was re-elected President, with Dr. F. S. Wallis, Vice-President, and the other officers with the committee of six were re-elected.

This meeting was followed by a lecture on the "Geology of Jan Mayen Island," by Mr. Ashby. This island is composed chiefly of volcanic rocks erupted since the retreat of the Ice Cap, and is not a remnant of the North Atlantic Tertiary basalt plateau.

On February 18th we had the pleasure of hearing Professor A. E. Trueman again, his subject being "Some stages in the Evolution of the Scenery of the Bristol District." He pointed out the many platforms at various levels, 200—750 feet, representing stages of marine and sub-aerial erosion in Pliocene times.

The last lecture of the Winter Session was delivered by Dr. P. O. Jones; his subject was "Some practical aspects of geology," showing that geology had uses to agriculture, engineering and water supply.

We had two Summer meetings, the third being cancelled on the outbreak of War, owing to transport difficulties. On April 29th Dr. Smith conducted a party to Clapton-in-Gordano, exposures in Lower Coal Measures being examined. On Wednesday, July 12th, the Secretary, Mr. F. Stenhouse Ross, conducted a party to examine Inferior Oolite exposures of Dundry Hill.

The Summer Field Meeting on Saturday, June 17th, of the parent Society, gave the members of the Section an interesting time with the exposures in the Inferior Oolite shown by Mr. F. C. Hudson.

At the opening of the Winter Session on October 21st, a lecture was given by Mr. J. P. Studer on "Some aspects of the Geology of Switzerland," showing very clearly the general structure of the Alps with their large series of overthrusts.

On November 18th Professor Gordon spoke on "Methods employed in the Study of Fossils." He traced the development of the preparation of microscopic slides, which show the internal structure of specimens, and the general prevailing conditions of climate, etc., at the time of deposition.

We have pleasure to welcome three new members in 1939, Miss L. Priscott, Mrs. F. C. Hudson and Mr. Maunder.

F. STENHOUSE ROSS, *Hon. Secretary.*

REPORT OF ORNITHOLOGICAL SECTION

1939



AT the Annual General Meeting in *January* members heard with much regret that, owing to other calls on his time, Mr. J. H. Savory would be unable to continue as President of the Section, an office he had held since the beginning of 1933. Warm tribute was paid to the enthusiastic way in which he had always encouraged the various activities of the Section. Members are fortunate in having so able a successor in Mr. H. Tetley.

Six ordinary meetings have been held, and although the last three took place in war-time, the average attendance throughout was only slightly less than in the past two years. Owing to lighting restrictions it was not possible to hold the usual Open Meeting in *November*.

At the *January* meeting the Secretary gave an account of a recent "Bird Trip to Friesland." Illustrations, shown with an epidiascope, were largely from photographs by Mr. J. H. Savory. In *February* Dr. John Berry journeyed from Southampton and gave a highly interesting, and no less entertaining, lantern lecture on "British Wild Geese." In *March* members heard an instructive talk on "Bird Migration," by Mr. R. D. Purchon.

The *September* meeting was devoted to discussion on the possibility of arranging a programme under war-time conditions, and it was decided that the Section should carry on. In *October* Dr. L. H. Matthews gave a comprehensive account of the "Life History of Petrels," following which, members were entertained by films showing Albatrosses, Cape Pigeons and other species in the South Atlantic. This lecture was preceded by a short account by Mr. G. H. J. Fursdon of a recent visit to Skokholm. The final meeting was held on the first day of *December* when Mr. B. W. Tucker, in lecturing, with slides, on "Bird Watching Abroad," gave detailed accounts of visits to such widely separated areas as Spitzbergen, the Pyrénées, the Camargue and Corsica.

Twenty-five members took part in a trip to Steep Holm on May 6th when good opportunities were had of seeing the Cormorant colony and the immense number of breeding Gulls. A Common Sandpiper, the first to be recorded for the island, was disturbed from the landing beach.

On June 15th, by kind invitation of Mrs. Hiatt Baker, a visit was paid to the gardens at Oaklands, Almondsbury, where members were privileged to view the unique collection of flowering trees and shrubs.

By invitation of the Bristol Photographic Society, members attended a meeting at the Cole Memorial Hall on December 13th when Mr. Eric Hosking gave a lantern lecture entitled "Nature in the Wild."

The Section continues as an annual subscriber to *British Birds*, also to the Ornithological Section of the Somerset Archæological and Natural History Society, and from the beginning of the year has been a corporate member of the British Trust for Ornithology. In addition, a contribution was again made to the Kite Preservation Fund.

It has been decided that those members who are away with either one of the Services shall remain on the Section's list in an honorary capacity during their period of absence. Membership now totals 75.

H. H. DAVIS, *Hon. Secretary.*

Account of the Annual and General Meetings

1939

THE 76TH ANNUAL MEETING of the Society was held in the Botanical Department of the University on January 19th, Professor Macgregor Skene in the chair. Forty-five members were present. The reports of the Hon. Treasurer, Hon. Librarian, and Hon. Secretary were presented and accepted. New Officers elected were : Vice-President, Mr. Croome Leach, and Hon. Treasurer, Mr. A. H. Peach. Professor Skene proposed a vote of thanks to Mr. Evens on his relinquishing the post of Hon. Treasurer, coupled with a note of appreciation for the work of the other Honorary Officers ; this was seconded by Mr. Stuart Thompson, and carried by the meeting. Professor Skene gave his presidential address on the subject " Longevity of Seeds."

599TH GENERAL MEETING was the 12th Annual Dinner, held at the Royal Hotel, College Green, on February 2nd, Professor Skene in the chair. The guest of the evening was Mr. Norman Whatley, M.A., the retiring Headmaster of Clifton College.

600TH GENERAL MEETING was held on March 2nd, in the University. Professor Skene in the chair. Mr. Kendall gave his lecture on Bridgwater Bay.

601ST GENERAL MEETING was held on Saturday, June 17th, at Frocester and Nympsfield Hill, and was led by Messrs. F. G. Hudson and G. E. J. McMurtrie. This was a good day for botanists and entomologists, and geologists found considerable interest on Selsley Hill.

The Exhibition Night was postponed owing to War conditions, and the time of the General Meetings was altered to 3 o'clock on Saturday.

602ND GENERAL MEETING was held in the Museum Lecture Theatre on November 4th. (This was the Open Meeting.) Professor Skene was in the chair, and the Films shown illustrated bird life and a botanical subject.

603RD GENERAL MEETING was held in the Botanical Department of the University on December 2nd. Professor Skene in the chair. Dr. L. H. Mathews spoke on " A Naturalist's Journey through Tanganyika." The lecture was illustrated by some very fine slides.

F. STENHOUSE ROSS, *Hon. Secretary.*

Bristol Botany in 1939

BY CECIL I. SANDWITH

(*Read in title, 2nd March, 1940*)

THE year 1939 proved to be generally more normal, but with a deficiency of sunshine which has been a marked feature of the past four successive years. There was not the destructive drought of 1938, nor an excessive rainfall; the wet months were January, October and November, and the season altogether was more satisfactory for the crops. Raspberries were plentiful in November, and in many gardens in Somerset apple and medlar trees were flowering when the fruit was being picked. Mr. H. O. Edmonds observed lilac bushes in bud on Brandon Hill in November, and several Forsythias with a few flowers open at the same date. January, 1940, after this, came as a shock, and as it will remain a landmark in history some reference may be made to the intense cold which came so unexpectedly in the latter half of the month, and the remarkable phenomenon of frozen rain. When it rains it is usual to look for a thaw, but this rain fell mercilessly upon everything and turned its victims into solid ice. Boughs of trees were weighed down, broken and broadcast, and the beautiful row of elms (*Ulmus stricta* var. *sarniensis*) in Tyntesfield Park was devastated and cracked, the broken limbs hanging forlorn. It will be well to note the effect of this on the coming season. The gift of prophecy might lead one to conclude that a cold winter coming in due season might foretell a prosperous year, and for those whose land was dug and ploughed for victory Jack Frost has been a grand fertilizer.

Now, let us look back. For several years no records were being published for Bristol Botany, and a hopeless state of apathy seemed to have possessed systematic botanists with the idea that the glories of the past were sufficient, that more was impossible. Five years ago it was decided to resurrect the past, and the one on whom the lot fell had to face in those first years a rather miserable one-horse show, but now the links in the chain are firmly fixed, and we realize the importance of continuity. Again we are linked with the past, and special thanks are due to Miss Fitzjohn and Mr. Ivor Evans for the work they have done.

Miss A. E. White must be congratulated on her rediscovery of *Herminium Monorchis* at Bath, a veritable link with the past, for

although this rare orchid was recorded from ' Hill pastures near Bath,' *Fl. Bathon.*, Mr. White writes in the Flora, ' There has been no confirmation of the Bath record in my time, and the plant was unknown to Mr. Flower.' Miss White also discovered *Aceras anthropophora*, in 1933, in a wood near Bath. The specimen was sent to the Natural History Museum, South Kensington, and the name confirmed.

Poterium officinale L. New to the Bristol district. In three rough grass meadows near Earthcott Green, G., Aug., 1939, *Mrs. B. Welch*.

In the Flora of Bristol, p. 36, the author gives a list of plants which ' are not improbably natives of the district but have not yet been detected. They should be looked for.' Of these, six natives have been found and crossed off since the publication of the Flora in 1912, and Mrs. Welch this year adds the seventh. The others were :

Viola lactea, 1917, *J. W. White*.

Agrimonia odorata, 1915, *H. S. Thompson*.

Jasione montana, *Mrs. Lainson*, 1876, see *Fl. Bristol*, where the record has not been accepted, owing to no proof. However, eventually the record was confirmed by *Mr. D. Williams*, 1912, who wrote that he had gathered *Jasione* at Clevedon in 1908, and enclosed a specimen, see *Journal of Botany*, 1918, p. 45.

Centunculus minimus, 1915, *Revd. E. Ellman*.

Orchis ericetorum, 1916, *Revd. E. S. Marshall*.

Sparganium neglectum, 1920, *C. and N. Sandwith*.

Three other plants in this list have occurred as casuals but are not included, being in no sense native in this district. There are five that might reasonably be expected to turn up one day :

Ranunculus Lenormandi, given in the Comital Flora for both W. Glos., v.c. 34 and N. Somerset, v.c. 6.

Cardamine amara, found as near as Stroud.

Luzula Forsteri ; is found in v.c. 34 and v.c. 6.

Alopecurus fulvus. Not yet recorded for v.c. 34 or 6, but is inconspicuous and easily overlooked.

Glyceria Borreri ; the same applies here, but localities on our coast do not seem impossible.

After the achievement of 1939 nothing, surely, is impossible.

Ranunculus arvensis Linn. Noticed only in one field on Parkmill Farm, N.W. of Thornbury, G., *Mrs. B. Welch*.

Draba muralis Linn. On an old stone wall opposite Hawkesbury Church, G., April, 1939, *Ivor Evans* and *G. H. Beacham*.

Silene noctiflora L. Cornfield, Marshfield, G., *C. and N. Sandwith*.

Hypericum calycinum Linn. A large patch naturalized on Old Down, Tockington, G., *Mrs. B. Welch*.

Medicago arabica Huds. (*maculata* Sibth.). Quarries and roadsides N.E. of Tytherington Church; and Ingst, G., *Mrs. B. Welch*.

Trifolium medium Linn. On shaly Silurian rock, bank by the roadside, W. of Damery, G., *Mrs. B. Welch*.

Coronilla varia Linn. Three large patches in old quarries at Tytherington, G., with *Carum Petroselinum* and *Sedum reflexum*, *Ivor Evans*.

Impatiens glandulifera Royle. Old quarry, Abbotsleigh; river bank, Bath, S., *Miss Fitzjohn*.

Ornithopus perpusillus Linn. Amongst grass on hill above Long Ashton, S., *G. Nichols*.

Prunus Padus Linn. Above the Gully, Durdham Down, Clifton, G. A fine tree which must have grown up amongst bushes unobserved and unrecorded until discovered flowering well in June, 1939, by *Mrs. A. G. Bell*.

Potentilla procumbens Sibth. On Lias, South Moon Riding, near Wickwar, G., *Mrs. B. Welch*.

Pyrus. *Mrs. Welch* very kindly undertook to trace the extension of the small spiny wild pears which are frequent in hedges in the Yate and Wickwar district and are of great interest. The results are given here, all stations being in Glos.: Bury Hill; Near Priestpool, Elberton, on the right of the road to Aust; between Littleton-on-Severn and Littleton Warth, 3 small trees; Elbury Hill, between Charfield and Wotton-under-Edge, 'Actually in the hedge of an orchard which includes pear trees'; between Peddington Manor Farm and Stone; Clapton, from Williselm Farm 100 yards down a lane towards Severn House Farm.

Epilobium adenocaulon Hsskn. $\times$ *montanum* L. Portishead, S., 1938, *J. P. M. Brennan*.

Oenanthe pimpinelloides Linn. Meadow near Fox's Home, Brislington, S., *Ivor Evans*.

Oe. Lachenalii C. Gmel. Near Hill, G., *Mrs. B. Welch*.

Heracleum Mantegazzianum S. & L. Six plants by a roadside ditch on the road from Thornbury to Oldbury, G., and *Vinca minor* on bank opposite, *Ivor Evans*.

Caucalis nodosa Scop. Sea bank S. of Littleton Warth, G., *Mrs. B. Welch*.

Sambucus Ebulus Linn. Twelve plants in a wood near Hawkesbury Church, G., *Ivor Evans*.

Antennaria margaritacea R. Br. Near Yate Station, G., *Mrs. B. Welch*.

Anthemis arvensis Linn. Earthcott Green; and Tockington Home Farm, G., *Mrs. B. Welch*.

Crepis biennis Linn. Railway bank, Ashley Hill, Bristol, G., *Ivor Evans*.

Hieracium maculatum Sm. Old Quarry, Tytherington; and railway bank between Patchway and main Bristol road, G., *Mrs. B. Welch*.

Taraxacum paludosum Schlecht., sens. lat. By a rivulet on Bathampton Down, S., Jan., 1940, *J. P. M. Brenan*. 'In young fruit but with the phyllaries tightly appressed. Near by was *Carex lepidocarpa* with fruiting spikelets still green.'

Calystegia sepium Br. var. *colorata* Lge. Roadside hedge (not garden) S.W. of Tytherington; and hedge of green road, Ingst, G., *Mrs. B. Welch*.

Mentha piperita Linn. Green lane, Aust, G., *Mrs. B. Welch*.

Melissa officinalis Linn. On a stone wall, near bank of Avon, Twerton, S., *Miss Fitzjohn*.

Ulmus Plotii Druce. Two trees, no doubt planted, near the Suspension Bridge, Clifton Down, G., *J. P. M. Brenan*.

U. stricta Lindl. var. *sarniensis* (Loud.) Moss. Several trees by the School House in College Road, Clifton, G. Tyntesfield Park, S. A row by the roadside at Bathampton, S., *J. P. M. Brenan*. This species is frequently planted.

Ceratophyllum demersum Linn. Pond, Hick's Common, Winterbourne, G., *Mrs. B. Welch*. This appears to be the first satisfactory record for district 5 of Gloucestershire, and for the Gloucestershire side of the Bristol district.

Vallisneria spiralis L. In the Berkeley Canal between Purton and Shepherd's Patch, G., Aug., 1939, *Mrs. B. Welch* and *C. Sandwith*. Just outside the district.

- Aceras anthropophora* Br. Found in a wood near Bath, S., 1933, *Miss A. E. White*. Specimen sent to the Natural History Museum, South Kensington.
- Herminium Monorchis* Br. Combe Down side of Bath, S., several plants in 1938, only one plant in 1939, *Miss A. E. White*.
- Narcissus Pseudo-Narcissus* Linn. Grass fields at Upper and Lower Strode Farms, Winford, S., *H. O. Edmonds*.
- Galanthus nivalis* Linn. On banks of Little Avon below the Bridge, Damery, G., *H. O. Edmonds*.
- Juncus compressus* Jacq. Olveston, G., west of the church, a few yards beyond a pump, *Mrs. B. Welch*.
- Sparganium simplex* Huds. Bradley brook, between Stoke Gifford and Winterbourne, G., *Mrs. B. Welch*.
- Lemna polyrrhiza* Linn. Pond just E. of Thornbury Station, G., *Mrs. B. Welch*.
- Zannichellia palustris* Linn. Pond, Aust Church, G., *Mrs. B. Welch*.
- Z. pedunculata* Reichb. Ditches on Severn shore near Cowhill: and pool at Oldbury-on-Severn, G., *Mrs. B. Welch*.
- Scirpus sylvaticus* Linn. Near Berkeley, G., on S. bank of Little Avon, W. of Floodgates Farm, *Mrs. B. Welch*.
- Cladium jamaicense* Cr. Yet another large patch of this species was found last June on the peat moor, at Walton Heath, S.E. of Ashcott Station, S., *C. and N. Sandwith*.
- Carex Otrubae* Podp. *C. vulpina* of the Bristol Flora. In a recent paper in *Journ. Bot.*, Sept., 1939, Mr. E. Nelmes has shown that the common British and Western European plant which we have always named *C. vulpina* L. is not Linnaeus's plant and must be identified with *C. Otrubae* Podp. *C. vulpina* is a plant with very distinctive characters occurring locally in S.E. England in Kent and Sussex, and perhaps near Oxford. All plants so far found in our district are evidently to be referred to *C. Otrubae*.
- × *C. axillaris* Willd. Roadside ditch, Olveston Common; 'St. George's withy bed'; roadside ditch N. of Peddington Elm; Clapton, ditch about half-way between Williselm Farm and Severn House Farm, G. *Mrs. Welch*, who records all these stations, thinks *C. axillaris* more frequent in this part of the district than was generally thought.
- C. strigosa* Huds. Oldbury-on-Severn, W. of cross-roads; Clapton, ditch half-way between Williselm Farm and Severn House Farm, G., *Mrs. B. Welch*.

Azolla filiculoides Lam. In the canal from Bathampton to the viaduct near Limpley Stoke, S., Dec., 1939, *J. P. M. Brenan*.

ALIENS. The following aliens are new to the district (coll. C. I. and N. Y. Sandwith unless otherwise stated):—*Chenopodium macrospermum* Hk. f. subsp. *halophilum* (Phil.) Aellen and *Poa bulbosa* L. at Avonmouth Docks, G.; *Parthenium Hysterophorus* L. at St. Philip's Marsh, G., 1900, *J. W. White* (Herb. Univ. Bristol); *Telekia speciosa* (Schreb.) Baumg., by Portway, G., 1938; *Silene Armeria* L., top of cliffs, Observatory Hill, Clifton, G., *G. Nichols*; *Gypsophila scorzonrifolia* Ser., at Fishponds, G.; *G. viscosa* Murr., St. Philip's Marsh, Bristol, G., *Ivor Evans*; *Dianthus deltoides* L., *Silene subconica* Friv., *Anoda cristata* (L.) Schlecht. var. *brachyantha* (Rchb.) Hochr., *Hedypnois rhagadioloides* (L.) Willd., *Crepis foetida* L., *Bromus scoparius* L., *Koeleria berythaea* Boiss. et Blanche (*J. P. M. Brenan*), *Lolium loliaceum* Bory et Chaub. (*J. P. M. Brenan*) and *Aegilops triuncialis* L., all on a tip on the Somerset side of the City; *Vicia tenuifolia* Roth var. *laxiflora* Griseb., on waste ground at Combe Down, Bath, S., *G. Nichols*; and *Fragaria indica* L., in a wood at Clapton-in-Gordano, S., 1935, *K. W. Nicholson* (Herb. Kew., det. *J. P. M. Brenan*).

In an article entitled "*Galinsoga quadriradiata* Ruiz and Pav. in Britain," in B.E.C. 1938 Rep., pp. 93-94 (1939), Mr. J. P. M. Brenan shows that our Bristol material (including specimens formerly referred to *Galinsoga parviflora* Cav. var. *adenophora* Thellung) is to be identified with this species rather than with *G. parviflora*. He gives a summary of the characters of both species, and identifies Bristol material as follows: *G. quadriradiata* R. et P., var. *hispida* (DC.) Thell., tip by Portway, G., 1938, *C. Sandwith*; and var. *hispida*, forma *Vargasiana* (Thell.) Mosseray, Avonmouth, G., 1927, *C. Sandwith*.

In *Journ. Bot.*, 1939, p. 248, Mr. H. S. Thompson has a note on the occurrence of *Orobanche Hederae* at Clifton and Bristol; and another, on the appearance of Bracken on our City Walls, in the July number of the same Journal (p. 218).

With the death last May of Mr. H. J. Gibbons, Bristol loses a keen field botanist who was for many years one of the most active members of the former University of Bristol Botanical Club, in the days when meetings were held at the house of Mr. J. W. White. Mr. Gibbons compiled an excellent Herbarium, chiefly of local species, and was particularly interested in our adventive flora, to which he contributed many records. In company with the late Mr. C. Alden he added *Limosella aquatica* to the Bristol Flora.

Ornithological Notes, Bristol District, 1939

By H. H. DAVIS, M.B.O.U.

(*Read in title, 2nd March, 1940*)

THE early weeks of 1939 brought a number of interesting visitors to the Bristol district, and, in particular, to the North Somerset reservoirs. Some of these may have been birds driven out by the severe weather in Northern Europe at the close of the previous year. In January a Water-Pipit, the first to be recorded for Somerset, was identified at Cheddar, and a Velvet-Scoter arrived at Blagdon where it remained until the last week of March—an unaccountably long stay for so scarce a bird inland. Goosanders and Smew were seen on various dates at Cheddar and Blagdon, while from the latter place, Red-breasted Mergansers were twice reported. Other noteworthy visitors at this time were a Great Northern Diver to Blagdon, and two Red-throated Divers to Cheddar.

Perhaps the most important feature of the year was the unusually late spring passage of Waders and Black Terns. A remarkable succession of observations made at the reservoirs from May 30th to June 4th included Ruffs, Sanderlings and Greenshank, while Temminck's Stints and a Wood-Sandpiper at Cheddar provided the first known occurrence of either species in the district. Even later was the passage of Black Terns which continued well into June. A pair of Garganey on Kenn Moor and a small party of Black-tailed Godwits at Blagdon are other notable spring records.

Observations at the reservoirs during the autumn migration were cut short owing to the cancellation of permits following the outbreak of war. This was much to be regretted, particularly with regard to Barrow Gurney where the low water level made conditions most attractive for Waders. Several visits were, however, paid to Blagdon, and Little Stints, Spotted Redshank and Black-tailed Godwits were reported. A Curlew-Sandpiper and a Greenshank are the only autumn records of importance from the Severn.

Among other events of special interest, mention may be made of a Hobby at Blagdon in September, a Merlin near Avonmouth in December and, once again, the presence of a drake Scaup at Barrow Gurney. Reports of an Iceland Gull at Cumberland Basin in January, and at Cheddar reservoir in April, and of a Glaucous Gull at Cumberland

Basin in December are also especially interesting. On each occasion the bird was in immature plumage, and this, together with other records in recent years, suggests that young examples of these northern Gulls may not infrequently wander to the Bristol Channel area.

Noteworthy breeding records include Ravens in the Avon Gorge, Cirl Buntings at Cheddar and Tufted Duck at Blagdon, while from Barrow Gurney there are reports of the successful nesting of Great Crested Grebes, and the breeding of Green and Lesser Spotted Woodpeckers in the same apple tree.

The following specific notes are the result of observations by members of the B.N.S., Ornithological Section. A more complete list of records for the Somerset side of the district will be included in the 1939 *Report on Somerset Birds*.

RAVEN (*Corvus c. corax*). The Avon Gorge eyrie was again occupied and young were successfully reared.

CIRL BUNTING (*Emberiza c. cirrus*). A female was seen at Little Stoke on March 27th, and a male was watched, feeding fledged young, at Cheddar on June 23rd.

WATER-PIBIT (*Anthus s. spinoletta*). One, in winter plumage, was viewed at close range along the water's edge at Cheddar reservoir on January 15th. Details noted were the pale greyish head, the warm brown coloration of the mantle and wings, the white outer tail feathers and, apart from the streaking, the clear white of the under parts. In size, carriage and flight it resembled a Rock-Pipit, but, in comparison, lacked the olivaceous tints and was a much cleaner looking bird (cf. *British Birds*, Vol. XXXII, p. 336).

PIED WAGTAIL (*Motacilla a. yarrellii*). As in the previous year, large numbers were found roosting in a withey bed at Saltford. Three hundred were counted on January 21st and over four hundred on February 18th.

PIED FLYCATCHER (*Muscicapa h. hypoleuca*). Twice seen on spring passage—a male at Almondsbury on April 30th and a male in Leigh Woods on May 4th.

GRASSHOPPER-WARBLER (*Locustella n. naevia*). Undoubtedly continues to nest on Clapton Moor where three seen, and the "reeling" song heard, on June 27th.

FIELDFARE (*Turdus pilaris*). There was a noticeable absence of Fieldfares in the autumn. This was probably due to a widespread scarcity.

BLACK REDSTART (*Phoenicurus o. gibraltariensis*). One was watched near Sand Point on February 4th and again on the 9th. This may have been the bird noticed there late in the previous December.

LESSER SPOTTED WOODPECKER (*Dryobates m. comminutus*). A most unusual record was established at Barrow Gurney when, in an orchard adjoining the old reservoir, a pair was found breeding in a tree also occupied by a pair of Green Woodpeckers.

HOBBY (*Falco s. subbuteo*). One was seen overhead at Blagdon reservoir on September 10th.

MERLIN (*Falco c. æsalon*). A female, or immature bird, was watched, in pursuit of a lark, over the river bank between Avonmouth and Severn Beach on December 3rd.

COMMON HERON (*Ardea c. cinerea*). Twenty-six occupied nests were counted at the Brockley Combe Heronry on April 29th and twenty-four at Banwell on May 20th. There was thus a total of fifty breeding pairs as compared with sixty-one in the previous year.

SHELD-DUCK (*Tadorna tadorna*). On February 14th four were frequenting Blagdon reservoir where the bird is by no means common.

GARGANEY (*Anas querquedula*). Two small ducks, showing conspicuous blue-grey wing patches, put up on Kenn Moor on April 16th were identified as a pair of Garganey.

PINTAIL (*Anas a. acuta*). A few, up to half a dozen in number, frequented Cheddar reservoir from mid-January to mid-February.

TUFTED DUCK (*Aythya fuligula*). At least one pair bred at Blagdon reservoir where a female with seven young was seen on July 16th.

SCAUP (*Aythya m. marila*). An adult male was frequently observed at Barrow Gurney from early January until May 10th, and (presumably the same bird) was again noticed during the last fortnight in August. This is the seventh successive year in which a single drake Scaup has visited Barrow reservoirs.

GOLDENEYE (*Bucephala c. clangula*). A few (including some adult males) were present at Blagdon and Cheddar from January to early April, or later. The largest numbers reported being ten at Blagdon on February 22nd and twelve at Cheddar on April 5th.

COMMON SCOTER (*Melanitta n. nigra*). One, an adult male, was frequenting Cheddar reservoir on August 4th.

VELVET-SCOTER (*Melanitta f. fusca*). One, apparently an immature male, visited Blagdon in January and was first identified on the 22nd. It was seen subsequently on various dates until March 26th and was usually to be found diving mid-way between the fishing lodge and the Butcombe creek. This is the only recorded occurrence for Blagdon reservoir (cf. *British Birds*, Vol. XXXIII, p. 26).

GOOSANDER (*Mergus m. merganser*). The following occurrences, of female or immature birds, were noted at the North Somerset reservoirs—one at Barrow Gurney on January 16th, one at Cheddar, on various occasions from January 15th to February 25th, and two at Blagdon on March 14th.

RED-BREASTED MERGANSER (*Mergus serrator*). Twice reported from Blagdon—four on January 9th and two on the 14th. All were “brownheads.”

SMEW (*Mergus albellus*). Frequently observed at the reservoirs from early January to the end of February. Seven at Blagdon on January 20th and twelve at Cheddar on February 10th were the largest numbers reported. As adult males have seldom been recorded it is a matter of interest that two were present at Blagdon on several dates in January, and it is much to be regretted that both were eventually shot.

GREAT CRESTED GREBE (*Podiceps c. cristatus*). Despite the lack of suitable cover, a pair bred successfully at No. 3 reservoir, Barrow Gurney. On July 2nd a nest with four eggs was found on the surrounding stone-work, and on August 26th the adults and two young were seen on the water.

BLACK-NECKED GREBE (*Podiceps n. nigricollis*). Two, in breeding plumage, visited Barrow Gurney early in June. They were noticed on the 8th and again on the 16th, but not subsequently. One was seen at Cheddar on August 19th and one at Blagdon on October 1st.

GREAT NORTHERN DIVER (*Colymbus immer*). One identified at Blagdon on January 9th, stayed until the 22nd or later.

RED-THROATED DIVER (*Colymbus stellatus*). Two visited Cheddar reservoir early in February. They were seen on the 4th, and one was again observed on the 12th. The other, a badly oiled bird, was found dead on the 13th and sent to the Bristol Museum.

OYSTER-CATCHER (*Hæmatopus ostralegus occidentalis*). A single bird was seen at Blagdon on February 10th. A scarce visitor to the reservoirs.

GOLDEN PLOVER (*Charadrius apricarius*). A party of nine was seen in flight at Little Stoke on April 6th. Twenty-one were counted, in company with Lapwings, at the Ubley end of Blagdon reservoir on October 1st, and a single bird was seen on the Avonmouth—Severn Beach mud-flats on the 6th.

GREY PLOVER (*Squatarola squatarola*). Noted on the Avonmouth-Severn Beach mud-flats as follows: four on September 24th, seven on October 6th and one on the 15th.

TURNSTONE (*Arenaria i. interpres*). Two, in breeding plumage, were watched on June 4th at Barrow Gurney reservoirs where the species has only once previously been recorded.

RUFF (*Philomachus pugnax*). Two were identified at the clay-pits adjoining the south bank of Cheddar reservoir on June 2nd. This is only the second spring record for the district.

SANDERLING (*Crocethia alba*). A single bird was present at Blagdon on April 2nd. Twice reported from Cheddar in the first week of June—one on the 2nd and five on the 7th.

KNOT (*Calidris c. canutus*). Only one record for the year—a single bird on the Avonmouth-Severn Beach mud-flats on December 17th.

CURLEW-SANDPIPER (*Calidris testacea*). One was seen along the river bank between Avonmouth and Severn Beach on September 17th.

LITTLE STINT (*Calidris minuta*). Twice met with at Blagdon during the autumn migration—one on August 13th and one on October 1st.

TEMMINCK'S STINT (*Calidris temminckii*). Three were watched at very close range at Cheddar reservoir on June 4th. They were in company with a Common Sandpiper which they strongly resembled excepting for the smaller size and less uniformly marked upper parts. The white outer tail feathers were plainly seen as the birds took flight. One repeatedly uttered the trilling courtship call. This it did from the ground (cf. *British Birds*, Vol. XXXIII, p. 86).

PURPLE SANDPIPER (*Calidris m. maritima*). Seen in small numbers on the mud-flats between Avonmouth and Severn Beach at the beginning of April, and again in November and early December. These observations were made at high water. Following the turn of the tide the birds repair to the shingle banks off Severn Beach where at least eight were watched on December 17th.

COMMON SANDPIPER (*Tringa hypoleucos*). The new reservoir at Cheddar has proved especially attractive to Common Sandpipers. Birds were abundantly met with on both passages and some were seen at almost all times in the summer. As many as thirty-six were counted on August 1st.

WOOD-SANDPIPER (*Tringa glareola*). On May 31st a single specimen of this scarce visitor to Somerset was frequenting marshy ground on the south side of Cheddar reservoir where it was seen and clearly identified by several observers. When viewed at close quarters it looked browner and more spotted than a Green Sandpiper, while, on taking flight, it seemed less erratic and lacked the black and white appearance of that bird. (For other details cf. *British Birds*, Vol. XXXIII, p. 86.)

GREEN SANDPIPER (*Tringa ochropus*). Single birds were noted at the reservoirs as follows—at Barrow Gurney on three dates in August, at Blagdon on various occasions from July 16th to August 27th, and at Cheddar on April 5th and August 28th.

SPOTTED REDSHANK (*Tringa erythropus*). Twice seen at Blagdon during the autumn migration—an immature bird on September 10th and an adult on October 1st.

GREENSHANK (*Tringa nebularia*). One was present at Barrow Gurney on May 30th, and one at Cheddar on the 31st. These are the first spring records for the North Somerset reservoirs. During the autumn passage two were met with at Barrow on August 26th, and up to three in number at Blagdon on various dates from August 6th to September 3rd. One was frequenting the river bank between Avonmouth and Severn Beach on September 17th.

BAR-TAILED GODWIT (*Limosa l. lapponica*). The only record for the year is of one seen near the mouth of the River Axe on September 21st.

BLACK-TAILED GODWIT (*Limosa l. limosa*). Reported from Blagdon reservoir on two occasions—a party of four on April 29th and a party of eleven on October 8th. Although autumn occurrences at Blagdon have been fairly frequent in recent years, there are but few spring records.

WHIMBREL (*Numenius ph. phaeopus*). As early as August 1st a single bird was seen along the Avonmouth-Severn Beach mud-flats.

JACK SNIFE (*Lymnocyrtus minimus*). One was flushed from marshy ground adjoining the old reservoir at Barrow Gurney on April 2nd.

BLACK TERN (*Chlidonias n. niger*). Observed at the reservoirs on both passages, but, as in the previous year, was more frequently met with in the spring. Records show, however, that the spring passage birds were several weeks later than in 1938. At Blagdon up to six in number were seen from May 30th to June 4th, and up to five at Barrow Gurney from June 1st to the 9th. Two were present at Cheddar on June 2nd and one as late as the 23rd. Seven were counted at Blagdon on September 3rd.

SANDWICH TERN (*Sterna s. sandvicensis*). A large sized Tern at Blagdon on April 12th was almost certainly this species.

COMMON TERN (*Sterna h. hirundo*). One was seen at Cheddar reservoir on April 19th, and one at the same place on June 7th and 8th. A single bird was present at Blagdon on June 11th.

GLAUCOUS GULL (*Larus hyperboreus*). One, apparently in second winter plumage, was frequenting the docks at Cumberland Basin during the last few days of December. It was first seen on the 27th, and when compared with a Herring Gull was noticeably larger, with a longer and more massive bill. When in flight it was a heavy looking buffish-white bird with an entire absence of black on the primaries, while the wings were strikingly broad in appearance. The only previous record in recent years is of an immature bird seen near Severn Beach late in December, 1938 (cf. *British Birds*, Vol. XXXII, p. 372).

ICELAND GULL (*Larus leucopterus*). Close views were obtained of one at Cumberland Basin on January 31st, and one was identified at Cheddar reservoir on April 19th. Both were in immature plumage. These records recall the visit of an immature bird to the Bristol district in 1933, and its ultimate stay over a period of two years.

KITTIWAKE (*Rissa t. tridactyla*). An adult was watched at Barrow Gurney on March 10th, and one, also adult, was found dead at Cheddar reservoir on April 5th.

WATER-RAIL (*Rallus a. aquaticus*). Two were seen along the River Avon, near Saltford on January 21st.

Note on a Temporary Exposure of 'Millstone Grit' in Pembroke Road, Clifton.

By F. S. WALLIS, D.Sc., F.G.S.

(*Read in title, 2nd March, 1940*)

EVIDENCE concerning the nature and position of the buried Palæozoic landscape in the Bristol District is always of interest and value. It is of even greater importance if it aids in an elucidation of present day features, especially those which cannot be adequately explained by examination of the surface strata.

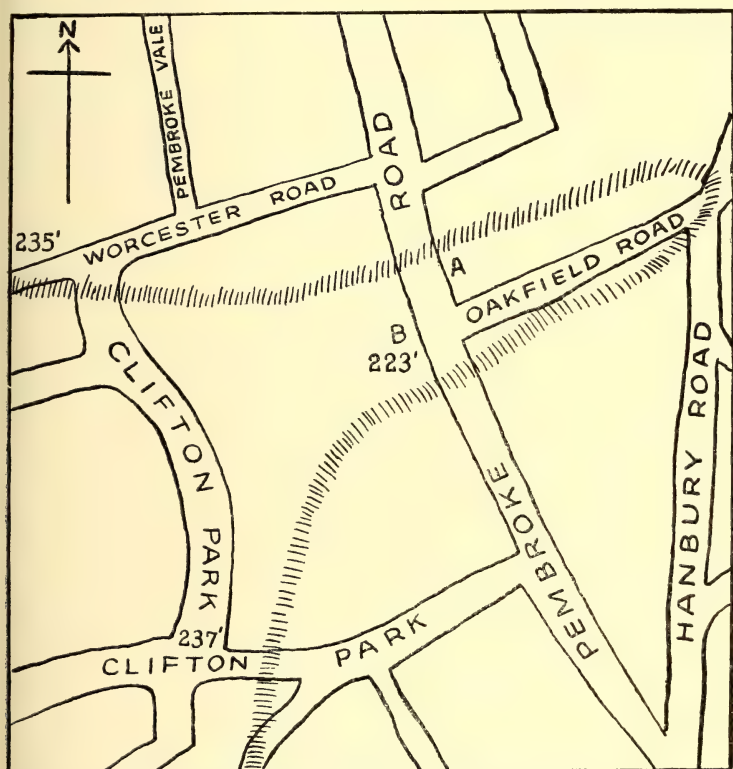
In connection with the laying of an electric cable in January 1940, a shallow trench was cut from Beaufort Road to Clifton Park in Pembroke Road, Clifton. The main interest of this temporary exposure centred in two small patches of 'Millstone Grit'—each occupying about a square yard—and situated near the junction of Pembroke Road and Oakfield Road. The exact sites of these exposures (A and B) are marked on the accompanying sketch (Fig. 1).

The rock is a compact, reddish quartzite dipping in a south-easterly direction at about 30° . No fossils were found, and it is possible that the exposures represent grit bands in the D_2 subzone of the Avonian. Lithology would, however, date the rock as of 'Millstone Grit' age.

The exposures were covered by a few inches of Triassic material, chiefly in the form known as Dolomitic Conglomerate. North-west and south-east of these exposures the trench was cut in Triassic beds consisting of normal red and yellow sandstones—grading laterally into red and yellow marls—together with patches of Dolomitic Conglomerate. The latter rock consisted of angular fragments of slightly oolitic limestone with isolated crinoid stems and "nests" of calcite, indicating a derivation from the D_2 subzone. Such evidence indicates that the exposures (A and B) are near the base of the 'Millstone Grit.'

Previous information concerning the area is meagre. It includes the well known map of the Bristol Coalfields and country adjacent (sheet 6) by William Sanders, published in 1864, where the surface beds are shown as Trias. In the Old Series, Sheet No. 35 (revised edition, 1872), Geological Survey Map, the beds are indicated as Dolomitic Con-

glomerate. In mapping the Clifton-Westbury-Kings' Weston area (*Proc. B.N.S.* Fourth Series, Vol. V, part II (1920 for 1918), 92-100), Professor S. H. Reynolds implied by his zonal differentiation that 'Millstone Grit' may be present at the site in question although on the map it was left uncoloured.



SKETCH MAP OF EXPOSURES IN PEMBROKE ROAD, CLIFTON.

Scale 0 ————— 500 Feet.

FIG. 1

In 1865, Fort Major T. Austin published a book on the Millstone Grit, dealing in particular with the Bristol District. Unfortunately, he does not indicate the rock in Pembroke Road although he records 'Millstone Grit' both to the east and south-east of the present exposures.

It would, therefore, seem probable that the small feature which crosses Pembroke Road at its junction with Oakfield Road (223 feet

O.D.) and is enclosed within the hachured lines in the sketch is due to a buried ridge of ' Millstone Grit ' covered by a thin layer of Trias. To the west, the feature widens and merges imperceptibly into the Palæozoic massif of Clifton Down and Observatory Hill. In a less pronounced form the ridge may be traced in an easterly direction across Whiteladies Road where it may link up with the exposures described by Austin (ibid. pp. 7 and 8) at Dundonald House (now No. 9 Woodland Road).

In conclusion, the writer wishes to stress the importance of recording local temporary exposures, especially those exhibiting the junction of the Palæozoic and Mezozoic rocks. In course of time it may be possible to construct a map depicting the features of the buried Palæozoic hills and dales.

Weather and Wildfowl

By H. TETLEY, B.Sc., F.Z.S.

(*Read in title, 2nd March, 1940*)

THE intense cold in Northern Europe in December, 1938, was no doubt responsible for the interesting influx of wildfowl that occurred in Somerset, as, of course, elsewhere, from that month onwards. Species that normally may winter further north were frozen out and had to move to a milder climate where food could be found.

Most striking of all was a herd, or herds, of Bewick's Swans that were seen by a number of observers by Langport and Muchelney, as well as near Catcott Burtle. In this area there had been heavy flooding for some time and large parts were completely under water, providing ideal conditions for Swans, with shallow water as a protection for them and plenty of grass which they can easily reach. Bewick's is the smallest of the three Swans on the British list; it has no knob at the base of the bill, as has the Mute Swan, nor does it have the curved swan-like neck or arched wings of the latter, but it carries its neck upright and its wings on the back, flat like the Whooper. It is, in fact, a small edition of the latter, but has less yellow on its bill.

The first news received of them was that there were 22 at Muchelney and 21 at Catcott Burtle on January 18th, 1939, and as these times coincided, there must have been over 40 of these fine birds in the county. Later they seemed to have joined up, as 42 were at Catcott Burtle on February 22nd to 25th. By the end of the month the water had dried up and the Swans had gone.

The writer was fortunately able to see 22 at Catcott Burtle on January 23rd. Here one portion of the road was a causeway between the floods on either side, and was partly flooded itself. In a corner of these floods the Swans were seen in a body, swimming about and feeding, while across the road were a number of Mute Swans. Of the 22, 19 were adults and 3 were young ones, the latter being easily distinguished by their greyish plumage. And it was interesting to note that they were evidently a family party, for on several occasions the two adults and three young rose on the wing together, flew round and settled in another part of the marsh, and were followed sooner or later by the others. While on the water, they kept up a pleasant conversation of babbling sounds. The swans at one time came close and were later

joined by two Mute Swans, so that comparisons could be made in a good light. In general appearance, the upright carriage of their necks, the slim body, thin necks and horizontally-carried slender bills, were the chief features of the Bewick's Swans. They were distinctly smaller than the Mutes and had noticeably thinner necks. In flight, their wings were pointed and their wing-beats quicker; and they were altogether more active. The colour of the adult's bill varied, seven of them having the ridge black to the base, thus dividing off the two patches of yellow, and twelve having the yellow continuous across the base of the bill; but in all, the front margin of the yellow patch was rounded, and not pointed as in the Whooper.

These Swans had come, no doubt in stages, from their breeding-grounds in North Russia or Siberia, first probably to Holland, where on the Ijssel Meer (Zuyder Zee) large numbers, up to 1,200, have latterly wintered. Then, when that was frozen, to this country.

On the reservoirs at Blagdon and Cheddar there were large numbers of duck, two estimates at the latter giving about 1,000 in all on February 4th and about 1,500 on February 25th. On the latter date, Wigeon, Shoveler and Pochard were the predominant ducks, and there were several hundred of the first and last, and at least 200 Shoveler, but Mallard, Teal, Tufted Duck, Goldeneye, Smew and Goosander were also present.

The winter was also noteworthy for the presence of unusual numbers of Smew. This, the smallest of the "saw-billed" ducks, is a winter visitor, and though the most regular of these three species (the other two being the Red-breasted Merganser and Goosander) does not usually occur in any numbers. Smew were on Blagdon between January 9th and March 26th, the largest number being six, on January 19th, which included two adult males. The latter are particularly scarce and are very striking birds in their black and white plumage which looks mostly white at any distance. Curiously enough, two adult males (not the same as the above two, which were shot) were at Blagdon on January 2nd, 1940, so possibly they may become more regular visitors. Smew were first seen at Cheddar in December, 1938, and numbers went on increasing up to a maximum of twelve on February 10th; five were still there on February 25th, but none were seen later. These were all "red-heads," i.e., females or young birds, which have a chestnut-red top to their head and conspicuous white cheeks which make them easy to identify. Four Red-breasted Mergansers, all females or young, were at Blagdon on January 9th and were busy diving in close

formation. A female Goosander was at Cheddar on January 15th and February 25th, and two were at Blagdon on March 14th.

Goldeneye, quite a regular winter visitor to the reservoirs, appeared in rather larger numbers than usual. Ten, including one adult male, were at Blagdon on February 22nd, and twelve, including three adult males, at Cheddar on April 5th, and this is the latest date on which any were seen.

A very unusual visitor to Blagdon was a Velvet Scoter which was first seen on January 22nd, and last seen on March 26th. It is in any case a very rare visitor to inland waters, being almost entirely maritime. The bird was a male, assuming adult plumage, distinguished from the all-black Common Scoter by a conspicuous white patch on the wing, and white patch or patches on the side of the head, as well as by the colour of its bill and feet. Scoters are characteristically heavy-looking ducks on the water, and it was thus possible to identify it as one on January 22nd in spite of a bad light and some rain. Later observations gave a chance of obtaining some more details. Most of the time it was busy diving, no doubt feeding on shell-fish at the bottom of the reservoir. On every occasion it half-raised its wings before diving, this again offering another method of identification when it was a long way off. Three dives were timed at 65, 67 and 70 seconds.

Additions to Bristol Insect Fauna (Diptera) since 1937

(See *Proceedings*, Vol. VIII, Part II, p. 209, 1936)

By H. L. F. AUDCENT, M.Sc.

(Read in title, 2nd March, 1940)

FUNGIVORIDAE (MYCETOPHILIDAE).

Leia crucigera Zett. S. Sharpham (A.) 10/9/25.

SCATOPSIDAE.

Scatopse picea Mg. var. *scutellata* Lw. S. Clevedon (A.) 26/9/39.

Scatopse (Holoplagia) bullata Edw. S. Clevedon (A.) 2/9/39.

CULICIDAE.

Chaoborus flavicans Mg. S. Nailsea (A.) 27/6/39.

TIPULIDAE.

Phylidorea (Limnophila) meigeni Verr. S. Priddy (A.) 6/6/37.

Limnophila (Elaeophila, Ephelia) mundata Lw. S. Dr. F. W. Edwards in British Short-palped Craneflies (see end of list), p. 79.

Pilaria (Limnophila) scutellata Staeg. (*subtineta* Zett.) S. as above, p. 88.

Gnophomyia lugubris Zett. G. as above, p. 104.

Taphrophila (Antocha) vitripennis Mg. G. as above, p. 47.

Dicranomyia decemmaculata Lw. G. and S. as above, p. 30.

Polymeda (Erioptera) squalida Lw. S. Kenn Moor (A.) 27/6/39.

EMPIDIDAE.

Rhamphomyia (Amydroneura) erythrophthalma Mg. S. Clevedon (A.) 26/9/39.

Hilara curtisi Coll. (*cilipes* auct. nec Mg.) S. Sharpham (A.) 2/6/36.

Tachydromia annulipes Mg. S. Kenn Moor (A.) 19/6/39.

Tachydromia cursitans Fab. S. Kenn Moor (A.) 16/6/39.

DOLICHOPODIDAE.

Argyra argentina Mg. S. Clevedon (A.) 25/6/39.

Chrysotus femoratus Zett. S. Shapwick (A.) 29/6/39.

Chrysotus neglectus Wied. S. Priddy (A.) 6/6/37.

Dolichopus lepidus Staeg. S. Kenn Moor (A.) 27/6/39.

Dolichopus vitripennis Mg. S. Priddy (A.) 6/6/37.

Leucostola vestita Wied. S. Berrow (A.) 26/6/39.

Xanthochlorus ornatus Hal. S. Kenn Moor (A.) 19/6/39.

DORYLAIDAE (PIPUNCULIDAE).

Dorylas (Pipunculus) confusus Verr. S. Priddy (A.) 6/6/37.

Dorylas (Pipunculus) semimaculatus Beck. S. Berrow (A.) 26/6/39.

SYRPHIDAE.

Brachyopa scutellaris R.D. S. Clevedon (A.) 23/5/39.

LARVAEVORIDAE (TACHINIDAE).

Lucilia silvarum Mg. G. Shepperdine (A.) 10/7/24 ; S. Moreton (A.) 21/5/33 ; Shapwick (A.) 29/6/39.

Blondelia (Lydella) nigripes Fall. S. Sharpham (A.) 2/6/36.

Melinda gentilis R.D. (*anthracina* Mg.) S. Clevedon (A.) 22/5/39.

Minella (Ptilops) nigrita Fall. G. Hallen (A.) 13/6/26 ; S. Shapwick (A.) 29/6/39.

Onesia biseta Villen. S. Clevedon (A.) 23/8/39.

Pollenia acarinata Wainw. (in lit.) G. Bristol (A.) 7/12/24.

Pollenia rudis Fab. var. *angustigena* Wainw. (in lit.) S. Sharpham (A.) 17/4/24 ; Backwell (A.) 13/5/34.

Panzeria (Ernestia) nielsenii Villen. S. Conkwell, Freshford (A.) 28/5/38.

Ptychoneura rufitarsis Mg. S. Clevedon (A.) 16/6/39.

Rhacodineura antiqua Mg. S. Clevedon (A.) 23/8/39.

Sarcophaga (Mehria) rosellei Böttch. S. Clevedon (A.) 1/6/39.

Sarcophaga (Robineauella) scoparia Pand. S. Clevedon (A.) 1/6/39.

Styloneuria discrepans Pand. S. Clevedon (A.) 20/6/34.

Voria (Athrycia) trepida Mg. S. Clevedon (A.) 18/5/39.

Zophomyia temula Scop. S. Sharpham (A.) 29/6/39.

MUSCIDAE (ANTHOMYIDAE).

Chortophila (Crinura) pilipes Stein. S. Clevedon (A.) 8/8/39.

Hydrotaea militaris Mg. S. Freshford (A.) 5/6/37.

Hylephila personata Coll. S. Portbury (A.) 10/6/39.

Limnophora (Spilogona) aerea Fall. S. Berrow (A.) 26/6/39.

Muscina assimilis Fall. S. Clevedon (A.) 8/8/39.

Mydaea tincta Zett. S. Nailsea (A.) 28/6/39.

Pegomyia albimargo Pand. S. Clevedon (A.) 20/10/39.

SCATOPHAGIDAE (CORDYLURIDAE).

Hydromyza livens L. S. Freshford (A.) 5/6/37.

PIOPHILIDAE.

Piophila vulgaris Fall. S. Clevedon (A.) 18/4/39.

SEPSIDAE.

Themira superba Hal. S. Nailsea (A.) 28/6/39.

TETANOCERIDAE (SCIOMYZIDAE).

Phaeomyia fuscipennis Mg. S. Clevedon (B.) 25/6/39; Leigh Woods (H.)

EPHYDRIDAE.

Hyadina guttata Fall. S. Clevedon (A.) 5/10/39.

Notiphila annulipes Stenh. S. Berrow (A.) 26/6/39.

LAUXANIIDAE (SAPROMYZIDAE).

Sapromyza dedecor Lw. G. Bristol (window) (A.) 1/7/36.

Sapromyza sordida Hal. (*inculta* Pand.). G. Bristol (window) (A.) 15/7/36.

ANTHOMYZIDAE.

Anthomyza sordidella Zett. S. Newton St. Loe (Chm.) 9/6/25.

CHLOROPIDAE.

Oscinosoma (Oscinis) laevifrons Lw. S. Shapwick (A.) 29/6/39.

AGROMYZIDAE.

Dizygomyza luctuosa Mg. S. Priddy (A.) 6/6/37.

Phytomyza nigra Mg. S. Priddy (A.) 6/6/37.

PHORIDAE.

Phalacrotophora berolinensis Schmitz. S. Clevedon (A.) 20/6/36.

CORRECTIONS

1. *Brachycoma erratica* Mg. (Vol. VII, Part V, p. 362, 1932). This was probably *Ptychoneura cylindrica* Fall. (teste Wainwright in *Ent. Mo. Mag.* Aug., 1938).
2. *Brachyopa bicolor* Fall. (Vol. VII, Part IV, p. 272, 1931). All records made by (A.) should be *Brachyopa scutellaris* R.D. (see Collin in *Ent. Mo. Mag.*, May, 1939).
3. *Zelima (Milesia, Xylota) sylvarum* L. (Vol. VII, Part IV, p. 276, 1931). The Olveston and Blaise Castle records are *Zelima xanthocnema* Coll. (see Collin in *Ent. Mo. Mag.*, May, 1939).
4. *Oxya parietina* L. (Vol. VII, Part VI, p. 437, 1933). Delete all records.

5. *Oxya flavipennis* Lw. Delete S. Morton (A.) 20/7/33 and substitute S. Brockley Combe (A.) 6/21.
6. *Oxya nebulosa* Wied. Add S. Moreton (A.) 20/7/33 ; Berrow (A.) 27/8/24 ; Shapwick (A.) 29/6/39.

RECENT LITERATURE.

- Edwards, F. W. BRITISH SHORT-PALPED CRANEFLIES (including *Cylindrotominae*, *Limoniinae* and *Trichoceridae*), *Trans. Soc. Brit. Ent.* Vol. V, Part I, 1938. This monograph is essential to all students of these groups. It is up-to-date in nomenclature and records. It contains over 200 text-figures and five plates of photographs of over 100 wings.
- Mesnil, L. ESSAI SUR LES TACHINAIRES. Publié par le Ministère de l'Agriculture, Imprimerie Nationale, 27 rue de la Convention, Paris, XVe. Published in 1939 ; price 20 francs ; two plates. This is an attempt at a natural classification of the genera of this very complex family.
- Collin, J. E. *Trypeta vectensis* sp. n. and other little-known British species of *Trypetidae*. *Ent. Rec.* Vol. XLIX, No. 3, March, 1937.
- Niblett, M. Notes on the Food-Plants of the larvae of British *Trypetidae*. *Ent. Rec.*, May, 1939.
- Niblett, M. Mediterranean and other Fruit-Flies. *Ent. Rec.*, June, 1939.
- Niblett, M. Gall-causing *Trypetidae*. *Ent. Rec.*, Feb., 1940.
- Wainwright, C. J. *Conops (Leopoldius) signata* Wied. in Great Britain. *Ent. Mo. Mag.*, Aug., 1935.
- Wainwright, C. J. A second species of *Leopoldius* Rond. *Ent. Mo. Mag.*, April, 1938.
- Collin, J. E. Notes on *Syrphidae* II (*Sphegina*). *Ent. Mo. Mag.*, Aug., 1937.
- Collin, J. E. Notes on *Syrphidae* III (*Brachyopa* and *Xylota*). *Ent. Mo. Mag.* May, 1939.
- Collin, J. E. The British species of *Lonchoptera*. *Ent. Mo. Mag.*, March, 1938.

Deserts*

By S. H. REYNOLDS, M.A., Sc.D., F.G.S.

(Read in title, 2nd March, 1940)

THERE is no generally accepted usage of the term desert, which has been employed in varying senses by different writers. The popular idea of a desert is, perhaps, a sand-covered flat, but this is as often as not incorrect as regards both the sandy character and the flatness. Many deserts have a highly diversified surface; in many also any sand which may be formed is swept away by the wind. There exist to-day approximately $11\frac{1}{2}$ million square miles of country which may be considered desert, i.e., about one-fifth of the land area; about half the African continent is arid, the Sahara alone being nearly as big as the whole of Europe. The arid region of North America has been estimated at about two million square miles.

Taking the amount of rainfall as the criterion determining the applicability of the term desert, it has been claimed that any country with an annual rainfall of less than 10 inches merits this designation.

Many factors, however, determine whether a region is to be regarded as desert, and deficiency of water, though by far the most important, is not the only one. Thus, a country formed of rocks which are very permeable, whether on account of their softness and porosity, or on account of the cracks and joints which traverse them, may become very barren or even of a desert character although there may be a considerable rainfall. For instance, many limestone areas, especially when of an upland character such as the Burren, Co. Clare (Pl. 2, B) the Causse district of south-central France, and the Carso or Karst district of Istria and western Yugoslavia tend to be semi-desert owing to the rapid escape of the water by underground channels. The same is the case in many lava-fields. Thus Thoroddsen¹ describes the barren tableland forming some 16,000 square miles in the interior of Iceland as a plantless desert, strewn with angular blocks of lava split by frost action, and presenting a most desolate appearance in spite of a heavy rainfall.

* For a general account of Deserts see Marr, *The Scientific Study of Scenery*, Ch. XV.

¹ Thoroddsen, Th., "An Account of the Physical Geography of Iceland," (1914) in *The Botany of Iceland*, London. Also "Explorations in Iceland," *Nature*, XXX, May to Oct., 1884, pp. 563 and 584.

Not merely the amount but the distribution of the rain must be taken into account, whether, that is, it is distributed throughout the year or all falls in a short period.

In contrast with the treeless or even plantless character of some limestone and lava districts with a heavy rainfall is that of the Kal-gourlie district of Western Australia which is nearly waterless and has almost all the characters of a desert but is well wooded, the trees being of a highly specialized type capable of thriving with a minimum of water.

Perhaps a desert may be defined as a country which, from climatic, meteorological, or geological reasons, is incapable of supporting more than a highly specialized and commonly scanty vegetation.

Deserts occur most frequently in sub-tropical countries, those of both northern and southern hemispheres being found between latitudes 20 and 45, i.e., within the trade wind belt. In the northern hemisphere are those of Central Asia, North-West India, Persia, Syria, Arabia, North Africa and North America. In the southern hemisphere are those of Australia, South Africa and South America. The conditions which most frequently give rise to them are when a mountain range separates a continental area from the vapour-laden winds blowing from the ocean. These winds are forced upwards by the mountains, are chilled, and the bulk of their vapour is precipitated. Thus the desert regions of the western Sahara, Kalahari, Gobi and the western part of the United States are all partly shut off by mountains from the moisture-laden winds.

Deserts are often extremely fertile when irrigated, owing to their rainlessness having allowed the accumulation of certain soluble constituents. Thus large areas have been irrigated in Australia by water obtained from artesian wells, in India, Egypt and the United States through the holding up of river water by means of dams. In various parts of the world, owing to increasing knowledge of how to make use of a slight and irregular rainfall, areas once of a desert character now yield good crops.

It has frequently been maintained that desert conditions in the world as a whole and particularly in Central Asia are on the increase, and there is no disputing the fact that the sites of many great cities of the past in Mesopotamia and Central Asia are now uninhabitable owing to drought (see p. 55).

Many limestone countries bordering the Mediterranean, such as Greece, Palestine and elsewhere have been rendered far more sterile

than they once were by the cutting down of forests for fuel and the introduction of that destructive animal the goat. The disappearance of forests has in many countries been followed by the washing away of the soil, always scanty in districts of pure limestone, or by the spreading of sand and gravel swept down by mountain torrents over formerly fertile tracts.

Types of desert.

From the point of view of surface configuration deserts have been divided into :

(1) Plateau desert, a fairly level, elevated and waterless plain with scanty vegetation. The surface may form a 'desert pavement' consisting of bare rock lying horizontally (*hammada*) or may be formed of hard loam often covered with small rock fragments; much of Moab and Edom is an arid plateau of this latter type.

(2) Erosion desert, which has a highly irregular surface with deep valleys sometimes containing salt lakes or sometimes oases. The central Sahara, the peninsula of Sinai, and the eastern desert of Egypt lying between the Nile and the Gulf of Suez illustrate this type of desert.

(3) Salt desert, as represented in Persia and on the west coast of South America, is perhaps the most desolate of all, and sometimes completely destitute of plant life.

(4) The Sand desert, typically seen in the Libyan desert west of the Nile, rivals the Salt desert in desolation.

Most deserts belong partly to one, partly to another type; the Sahara, for example, is partly a sand-sea composed of great dunes, partly a rock-desert of diversified character. Whether shifting sand masses are produced may depend on the character of the rock. Thus, in the Karroo, where marly rather than sandy sediments prevail, there is little formation of sand. Further, as Walther² points out, sand-seas are only found in areas where the wind blows sometimes from one quarter, sometimes from another. If the prevalent wind in any particular district is always in the same direction the sand will not accumulate, but be swept on, and a rock desert may be found.

A particular type of what may be described as erosion desert is well represented by the 'Bad Lands' of some of the western states of

² Walther, J., *Das Gesetz der Wüstenbildung*, Berlin, 2nd. ed. (1913). For a detailed review of the 2nd edition by W. F. Hume see *Geol. Mag.* (1914), pp. 18 and 73.

America, such as South Dakota and Wyoming. The conditions favouring 'Bad Land' development are (1) a low rainfall more or less concentrated in heavy showers, (2) scarcity of deep-rooted vegetation, (3) slightly consolidated, homogeneous, fine-grained sediments lying horizontally at a considerable height above the main drainage channels, so as to allow a rapid run off. The scarcity of vegetation allows the occasional heavy rainstorms to cut deep ravines in the soft sediments. In the White River Bad Lands near Scenic, S. Dakota (Pl. 1, A), the 'Bad-Land' topography tends to be confined to a rather narrow tract bordering each section of the plateau.

*Eroding agents in deserts.*³

These include (a) changes of temperature (insolation); (b) wind; (c) water.

(a) Erosion due to changes of temperature (insolation).

Owing to the lack of aqueous vapour in the air the rocks after being intensely heated in the sun—a temperature of 80° C.=176° F. has been recorded—cool so rapidly by radiation after sunset that a daily range of upwards of 130° F. may be attained. The resulting expansion and contraction fracture the rocks, and, in particular, cause granite to 'exfoliate,' slabs sometimes many feet long flaking off. The detached material is often too much to be removed by the ordinary denuding agencies and accumulates as masses of scree. In the Karroo the effects of temperature changes may be very impressive; large blocks of dolerite may be seen shattered by insolation and surrounded by smaller blocks split off them in this way. Several authors give figures of pebbles fractured by temperature changes (see *Geol. Mag.*, LXI, 1924, Pl. XX). Walther has illustrations of huge blocks of granite split by the same process. The large block from near Bellari, India, shown in Pl. 5 A may have been split in similar fashion, but another possibility is that the splitting was due to the contraction of a greatly heated rock following chilling by a sudden rainstorm. Such chilling may also cause an intersecting system of close set joints to open on a flat surface, and along these the rock may break up into angular blocks.

Changes of temperature may sometimes be the only erosive agent operating in a particular locality for a long period.

Another feature of desert rocks dependent on heat is the occurrence

³ J. W. Evans' Presidential Addresses to the Geologists' Association, XXIV (1913) and XXV (1914), on 'The Wearing down of the Rocks' contain much of great interest regarding arid conditions. See also 'Discussion on the Physiography of Arid Lands,' *Rep. Brit. Ass., Australia* (1914), pp. 263 and 271, and *Geol. Mag.*, 1914, pp. 419-425.

of a peculiar hard black surface-film or crust, commonly termed desert varnish. The film contains iron, manganese and phosphoric acid, and is due to the intense heat drawing all the moisture, with these substances in solution, to the surface where insoluble oxides are formed. When rock masses are covered with this crust, it sometimes flakes off, exposing softer and more weathered rock which may crumble away, producing remarkable hollows behind the protective crust. Evaporation is also responsible for the deposition in many arid localities of surface limestone, surface quartzite and surface ironstone (pan).

(b) *Wind Erosion.*

Wind is certainly the greatest eroding and transporting agent in deserts, and one of its most characteristic features is that, unlike water, it can work uphill, so that its action may be spread over the whole countryside instead of being confined to the bottoms of the valleys. The general wearing away of all less durable rocks, the scooping out of the softer patches, the polishing of the surface (Pl. 4 B), and the production of faceted stones (dreikanter) are all characteristic erosive effects. Remarkable examples from Peru of the hollowing of limestone blocks, primarily by wind action, are figured in the *Geol. Mag.* LXI (1924), Pl. XIX.

Flat-topped hills or mesas such as those from the White River Badlands shown in Pl. 1 B are a common feature of arid lands though not confined to them.

The occurrence of wind erosion by no means necessarily implies desert conditions, for it is primarily dependent on the lithological character of the rocks, being specially characteristic of sandstones. British examples include the Brimham rocks near Harrogate and others from the Yorkshire Millstone Grit, also well-known instances from the Wealden sandstone near Tunbridge Wells. American examples frequently figured are those of the 'Garden of the Gods,' Colorado Springs. The Brimham Rocks and Colorado Springs examples illustrate well the fact that the sand drift keeps low, as is shown also by the fretting away of the lower part of the facades of some of the Egyptian temples.

Nielsen⁴ refers to the enormous erosive effect of wind and to the violence of the 'sand' storms in Iceland. In the Faroes, too, in exposed situations, even the close-growing vegetation cannot protect the underlying strata from the violence of the wind. The importance

⁴ Nielsen, N., Review in the *Geog. Journ.*, LXXXIII (1934), of a Danish memoir entitled 'Contributions to the Physiography of Iceland, with particular reference to the Highlands W. of the Vatnajökull (1933).'

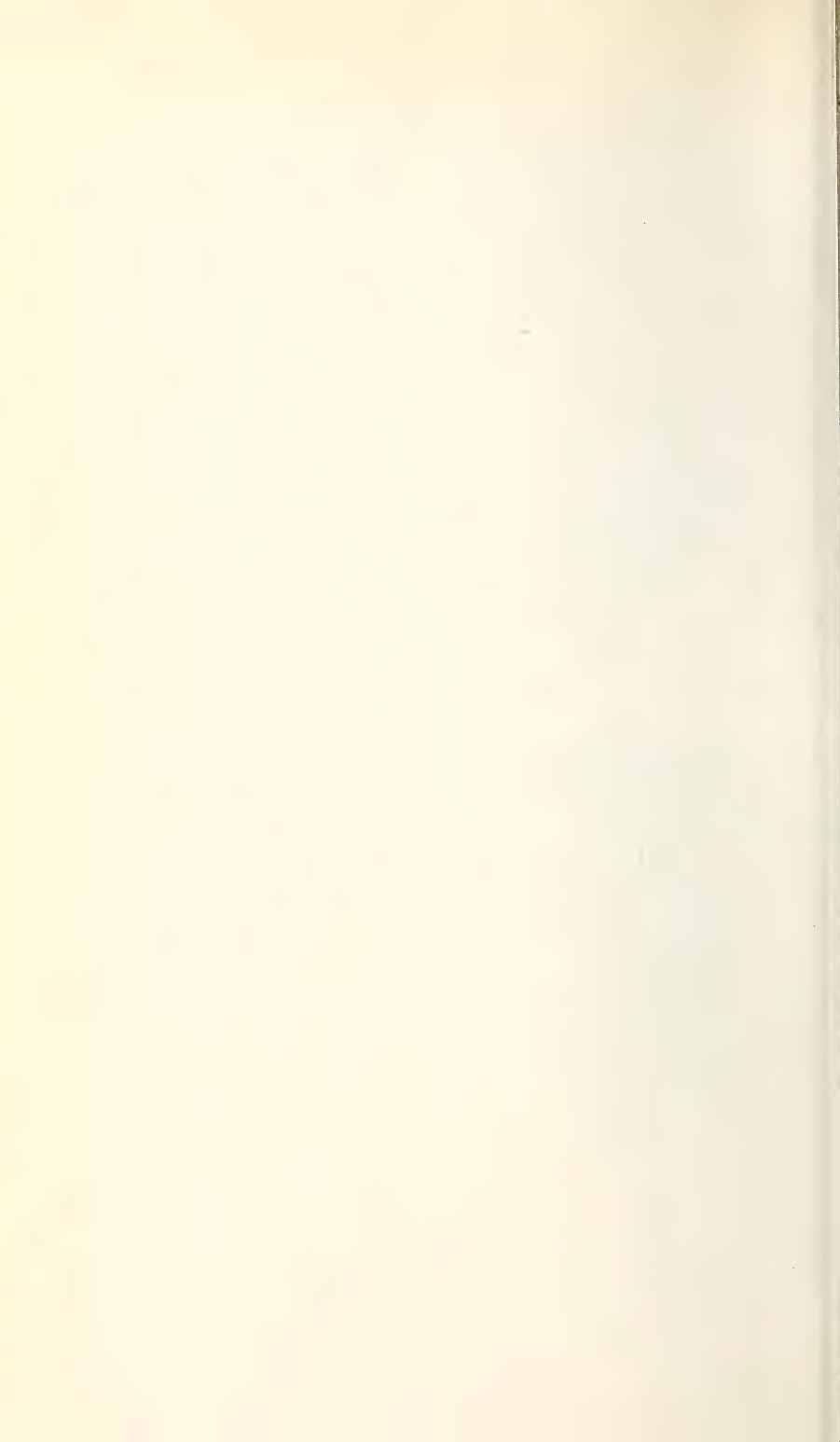


(A) BAD-LAND TOPOGRAPHY, NEAR SCENIC, S. DAKOTA, U.S.A.



(B) FLAT-TOPPED HILLS OR MESAS IN THE WHITE RIVER BAD-LANDS NEAR SCENIC, S. DAKOTA, U.S.A.

The hard band of limestone capping the mesas is being undercut by wind action.





(A) VIEW IN THE WILDERNESS OF JUDAEA NEAR THE LOWER END OF THE
JERICHO ROAD.

The rocks are Cretaceous limestones.



(B) VIEW IN THE BURREN, CO. CLARE, IRELAND.

The rocks forming this typical 'karst' landscape are Carboniferous Limestone.





(A) BECHUANALAND. ARID COUNTRY NEAR PALACHWE, SPARSELY COVERED WITH INTENSELY SPINY ACACIAS.



(B) SAGE-BUSH IN MOHAVE DESERT, CALIFORNIA, U.S.A.





(A) GRANITE HILLS RISING FROM THE DESERT E. OF THE 6TH CATARACT, KHARTOUM.



(B) GRANITE HILL SMOOTHED BY THE SAND-BLAST, NEAR KHARTOUM.

Photo: G. W. Grabham





(A) NEAR BELLARI, SOUTHERN INDIA.

The smooth face, partly in shadow, is of a mass of granite split, possibly by insolation, more probably by the contraction following the chilling by a sudden rainstorm of rocks which had been highly heated in the sun.



(B) VIEW IN THE JORDAN VALLEY NEAR JERICO.

On the left, the high ground is the Wilderness of Judaea, the culminating point being the Mountain of Temptation. On the right is the Jericho oasis with its palm trees.





(A) NEAR ALIWAL NORTH, SOUTH AFRICA

Shows the effect of heavy rain on soft rocks with only a slight cover of vegetation.

Photo : Mrs. Bancroft Clark



(B) NEAR BEAUFORT WEST, SOUTH AFRICA. A TYPICAL KARROO LANDSCAPE.
The distant hills are capped by sheets of dolerite.



of wind erosion in arid regions depends partly on the fact that there is no protection for the rocks analogous to that afforded by snow in arctic regions, and dense vegetation in humid temperate and tropical regions.

The effects of wind erosion in Africa have been graphically described by Walther, but it has been pointed out by several writers that some of these results may be produced under very different physical conditions in the Alps and in the Antarctic respectively. Thus faceted stones (dreikanter) of glacial origin are described by Griffith Taylor⁵ from the Antarctic.

A characteristic feature of many desert regions is the remarkably level character of the plain and the suddenness (Pl. 4 A) with which the hills rise from it.⁶ Such a state of affairs, though owing something to the outwash accompanying the storm bursts which may at long intervals of time visit any desert region, no doubt primarily depends on the filling up of depressions and general levelling through the transport of material by wind action.

The transporting power of wind (deflation) in desert regions is quite as remarkable as its erosive power. Thus, Walther describes in the Libyan desert great walls of granite rising to a height of 6,000 feet but with the base swept free of talus by the wind. Fine grained powdery dust may sometimes be transported by the wind for hundreds of miles from its place of origin, and much modification of the surface features may thus be produced. The most remarkable example of such a wind-borne dust deposit is the loess of China and much of central Asia. Chinese loess, which is formed of material carried by the wind from the desert of Gobi, is normally a structureless clay or loam with some sand, containing numerous land shells and remains of other terrestrial animals. It is very homogeneous and coherent and preserves the same character over vast areas. Its distribution is independent of height above the sea, and in China it ranges up to a height of 8,000 feet, and has been claimed to reach a thickness of as much as 1,500 feet, though according to Barbour, 600 feet is the greatest thickness actually observed. It has a strong tendency to vertical jointing so that valleys in it commonly have the form of ravines with perfectly vertical walls. The peculiar erosion forms and the readiness with which it may be

⁵ Discussion on the Physiography of Arid lands, *Rep. Brit. Ass., Australia*. 1914, p. 366.

⁶ On the other hand much attention has been paid by American geographers to 'pediments,' i.e., inclined rock-floors often thinly strewn with debris, but produced by the planation of the solid rock and forming a transition from the hills to the plain.

hollowed out into chambers depend on its vertical jointing and on its soft yet firm and fine-grained character. Its aeolian origin, as originally claimed by Richthofen,⁷ is probably now universally accepted, but he did not maintain that desert conditions were essential for its formation. Further, much of the Chinese loess has been redeposited by the great rivers, and hence has features characteristic of a water-borne deposit in addition to or replacing those of an aeolian deposit. In much of China, where thick deposits of loess occur, the conditions are not now favourable for its formation. The mammalian fauna of the loess is essentially of a steppe character.

Large areas of loess occur also in the northern Argentine, and deposits of analogous character cover a large area in the South Island of New Zealand.

While China is the country where loess is thickest, deposits of the nature of loess are very widespread throughout the eastern European plain and in the central states of the American Union. In both these cases the material seems to be the 'rock flour' produced by glacial erosion. Such material was spread out as a kind of apron in front of the ice sheet; it was then transported by the rivers and in particular was widely spread in the Mississippi valley when the river was in flood. Of the three great areas for loess—Central Asia, Eastern Europe and the central part of the United States, the first of the three seems to be the only one where it is primarily due to wind. In all three areas the rivers have distributed it in their flood plains, and finally, in the Mississippi valley, much loess originally deposited in the flood plain, was redistributed by the wind when the floods subsided.

The fertility of the Nile valley, though due in the main to the fine silt and loam of the annual floods, owes something to wind-borne material of desert origin.

Remarkable observations on the transport by wind in Rajputana are recorded by Holland.⁸ Shells and foraminifera which had been carried by the wind for 500 miles inland were found undamaged. Of salt, it was found that 120,000 tons was carried past a front of 300 kilometres in eight months during 1908. The amount of salt carried by the wind into Rajputana during a year probably exceeds 200,000 tons.

Wind erosion is becoming an increasing danger in the semi-arid lands which form the world's chief granaries. In parts of N. America and

⁷ Richthofen, F. von, 'On the mode of Origin of the Loess,' *Geol. Mag.* (1882), p. 293. For modern work on the loess see G. B. Barbour, 'The loess of China,' *Smithsonian Report*, 1926, and 'The Loess Problem of China,' *Geol. Mag.*, LXVII (1930), p. 458.

⁸ Holland, T. H., *Annual Reports of Geol. Survey of India*, 1904–09.

the Argentine and to a less extent in Russia, the fertile prairie soil is being rapidly swept away as a result of destroying the original grass cover.

(c) *Water Erosion.*

In many desert countries nothing is more conspicuous than the fact that much erosion is the work of running water although at the present day such regions may be practically rainless. This, no doubt, in some cases implies change in geographical conditions, the erosion having taken place before the present aridity was established. But much must be attributed to the intense, if short-lived, effect of the sudden cloudbursts (*seil*) which occur at intervals often of many years. Hume states that there is probably not a valley in upper Egypt which has not at one time or another been the scene of such a storm, and that the Arabs report the recurrence in certain localities of such floods about once in ten years. Elsewhere, on the other hand, very many years, according to Hume perhaps centuries, may elapse before another storm breaks in the same place. A characteristic feature of the desert rain-storm, and one associated with the level surface so common in arid lands, is the widespread character of the torrent, the water often not following any definite channels, but spreading far and wide in a broad sheet. As a result, level delta-like deposits of wide extent are produced. Many American geographers ascribe the major part of desert erosion to the action of these 'sheet-floods' due to occasional cloudbursts.⁹ The heavily burdened water tends to do more lateral cutting than is the case with normal streams, and part of the rock-smoothing, instead of being the work of wind-borne sand, may be due to water-borne sand.

*British Deserts*¹⁰

As in many other countries, so in Great Britain there is evidence of the occurrence of desert conditions in several widely separated geological

⁹ Knight (*Letters from the Soudan*, p. 254), mentions that, during Kitchener's advance in 1896, a tremendous storm swept away 12 miles of railway embankment. Although the connection with deserts is not immediate, allusion may perhaps be made to certain remarkable 'cloudbursts' in England, viz., at Langtoft in the Yorkshire Wolds (*Brit. Ass. Geol. Phot. C. 2*); at Louth, Lincolnshire (*Geog. Journ.*, LVIII (1921), p. 390), and in Westmorland (*ibid.* LXXIX (1932), p. 156).

¹⁰ See Goodchild, J. G., 'Desert conditions in Britain,' *Trans. Geol. Soc., Edinburgh*, VII (1897), p. 203, and *ibid. Glasgow*, XI (1898), p. 71. Also Lomas, J., 'Desert Conditions and the Origin of the British Trias,' *Proc. Liverpool Geol. Soc.*, X, (1905), p. 172.

periods. Thus, it is certain that the British 'New Red' (Permian and Trias) was accumulated under continental conditions of an arid or semi-arid character, while the case seems the same as regards the 'Old Red' and the Torridonian. All these deposits were laid down, not on the smooth floor of the open ocean, but in land-locked seas and salt lakes or on an irregular land surface. All are characterised by a predominantly red colouration, due to the presence of ferric oxide coating each sand grain, and depending on the absence of the organic acids which normally act as reducing agents.¹¹ But though of continental origin, it is not always clear which strata were deposited in lakes or land-locked seas and which on the dry land itself. The beds of rock-salt of the Trias are proof not merely of the presence of salt lakes but of very great concentration in them. In the British Isles we have no such deposits as those of the highly soluble salts of potassium and magnesium found at Stassfurt in central Germany, the presence of which indicates practically complete drying up. Arid conditions are indicated by other British deposits than those of rock-salt, thus the pebble beds of the Bunter and Old Red Sandstone seem to be torrent-fed delta fans like those of desert regions. The Permian breccias of the Lickey Hills are commonly regarded as scree deposits, the fragments having been split off by insolation. The brockrams of the north of England probably represent masses of material split off under desert conditions from the high land of the Pennine Chain and swept by the occasional heavy rainstorms down to lower ground. The 'millet seed' sand of the Bunter points to wind action, while the current-bedded sandstones of both New Red and Old Red may sometimes be of aeolian, sometimes of aqueous origin. The marly beds of the Keuper of Cheshire have been compared to deposits due to the blowing of fine dust from the Egyptian desert into the Red Sea.

The following are examples of ancient wind-worn surfaces in the British Isles:—that below the Torridonian, that between the Upper and Lower Old Red Sandstone of Forfar (Angus), that below the Lower Permian of Lillieshall, Shropshire and that below the Trias of Mt. Sorrel, Leicestershire (see *Brit. Ass. Geol. Phot. C. 19.*).

It has been maintained by Bailey¹² that the Chalk sea was bounded by land of a desert character. He argues (1) that the rounded and polished

¹¹ It may be noted that a red colouration, while so frequent in the desert deposits of past geological periods, is not specially characteristic of those of the present day.

¹² Bailey, E. B., 'Desert Shores of the Chalk Sea,' *Geol. Mag.*, LXI (1924), p. 102.

quartz grains which are locally so common in the Chalk are like those of deserts, (2) that the purity of the Chalk points to the absence of terrigenous sediments and hence to the lack of rain.

Dreikanter have been found in the Torridonian and at various places in the Permian and Trias: thus Watson and Hickling figure (*Geol. Mag.*, 1914, p. 431) typical examples from Moray. Their presence does not, however, necessarily imply desert conditions, for examples found in the Pleistocene near Nottingham, at Lillieshall in Shropshire and elsewhere, have been attributed to the action of wind radiating from an ice-sheet and sweeping over barren marginal areas of loose sand and boulders.

*Desert Vegetation*¹³

The characteristic features of desert vegetation are directed to two ends (1) to secure the economy of water by checking transpiration, (2) to resist the attack of plant-eating animals.

Transpiration is checked (a) by the occurrence of a thick covering of felted hairs, (b) by the reduction in number of the leaves, as in many desert Acacias, (c) by the vertical disposition of the leaves, as in Gum-trees (*Eucalyptus*), (d) by their complete disappearance, their work being carried out by the thick fleshy stem as in the Opuntias now found in all hot countries, in the Cacti of tropical America and in the candleabra Euphorbias of Africa.

The attacks of animals are countered (a) by the felted hairs alluded to above, (b) by the tough epidermis of such plants as *Agave*, (c) by the terrible thorns of Opuntias and many desert Acacias (Pl. 3 A), (d) by the tussock habit, when the plant forms a compact cushion standing isolated from its neighbours and protected as in the Australian Spinifex (*Triodia irritans*) by a dense mass of radiating leaves, each ending with a formidable spine, capable of inflicting a severe wound; in the Chilian and other deserts many types of plant may assume the tussock habit, (e) by the aromatic character of such plants as *Artemisia*, and (f) by the bitter or poisonous juices of many plants such as Sodom apples (*Calotropis procera*).

European Deserts

While no part of Europe shows desert characters depending on deficient rainfall, some of the larger limestone areas, such as the Causse in

¹³ In Professor Schimper's classical '*Pflanzen-Geographie*,' Jena, 1898, desert vegetation is described in Ch. IX.

south-central France and the karst or Carso of Istria and part of Jugoslavia,¹⁴ are barren and streamless, the chief cultivation in the Carso being in the dolinas or solution hollows into which the soil is washed. Before the French Revolution of 1789 the Causse was largely forest covered, but the cutting down of the trees led, as in so many other areas, to the washing away of the soil.

The areas of blown sand at many points on the coast of Europe present many of the features of deserts, and much effort is often required to check the still further spread of the sand. Perhaps the most remarkable of these areas is the Landes of the Bay of Biscay where the conditions are described as being in part truly desert, with complete absence of plants. There is a great range of temperature, and the area has many of the features of a hot desert in summer and a cold one in winter. The further spread of the dunes has in this area been checked by the planting of conifers. In other districts, such as the Lancashire coast, the same result has been obtained by the planting of Marram grass. In Denmark the speed with which the dunes have moved has been remarkable; within 30 years their advance has overwhelmed a church, and passing on, has disclosed it again. The Culbin area of Banff is one where the onward movement of dunes has disclosed a forest of dead trees.

Icelandic Deserts

In Iceland again it is not shortage of water which produces desert conditions. The chief area, the Odadahraun, a district of some 16,000 square miles which extends northwards from the great Askja volcano and is almost completely devoid of life owes its aridity to the porosity of the rocks, the shifting volcanic 'sand' and the violent winds. The winds are said to be the determining climatic factor since, when the work of the wind is hampered, small oases appear.

Much of the Vatnajökull, the largest ice cap in Europe, is bounded by what may be termed a 'sand and boulder desert,' the result of the violent deluges of water, rocks and volcanic ejectamenta which accompany the periodical outbursts from a great crater in the ice-cap. Large boulders have been swept many miles from their point of origin.

Deserts of Central Asia

Nearly all authorities agree as to the progressive desiccation of

¹⁴ Wray, D. A. 'The Karstlands of Jugoslavia,' *Geol. Mag.*, LIX (1922), p. 392. The paper includes a general account of Karst phenomena.

central Asia (Kropotkin,¹⁵ E. Huntingdon,¹⁶ Sven Hedin,¹⁷ Aurel Stein,¹⁸ Sowerby¹⁹). Huntingdon describes how, in Chinese Turkestan, gradual desiccation is marked by dead trees along the banks of dried-up rivers which have in their lower courses the ruins of towns. A. Stein describes in the outer Kuenlun a maze of deep cut gorges which can only be due to prolonged water action, but now only on rare occasions does rain or snow fall. Sven Hedin alludes to irrigated fields and ruins of cities and monasteries amongst deserts where life is now impossible. Sowerby describes how the desert conditions of central Asia are creeping S.E. into northern China and are apparent as far as the Yangtsi. Kropotkin considered that recent exploration had yielded much evidence that the whole of central Asia has been undergoing desiccation since the beginning of the historic period.

Gregory²⁰ on the other hand, after fully discussing the question, concludes that the claim of general increased desiccation in Asia is not proved, the facts pointing to the shifting of desert areas rather than to their increase.

Deserts of South Western Asia

Much of south western Asia is of a desert character. The first such region as one proceeds from east to west is the Thar or Indian desert of Rajputana, followed by the Helmand desert of southern Afghanistan. Much of Baluchistan²¹ and of Persia, both northern and southern, is very arid, the great Khorasan desert in the north-central part of Persia being one of the most unmitigated salt-wastes of the world. Blanford²² considered that these Persian deserts, all of which enclose swamps or salt lakes, are the sites of former great lakes or inland seas analogous

¹⁵ Kropotkin, Prince, 'The Desiccation of Eur-Asia.' *Geog. Journ.*, XXIII (1904), p. 722.

¹⁶ Huntingdon, E., 'The Rivers of Chinese Turkestan and the Desiccation of Asia,' *ibid.*, XXVIII (1906), p. 352.

¹⁷ Hedin, Sven, *The Scientific results of a Journey in Central Asia, 1899-1902*, Stockholm. (A popular edition entitled *Central Asia and Tibet* is published by Hurst & Blackett.)

¹⁸ Stein, A., 'Innermost Asia, its Geography as a factor in History,' *Geog. Journ.*, LXV (1925), p. 377.

¹⁹ Sowerby, A. de C., 'The Menace of the Gobi to China' (review), *ibid.* LXV (1925).

²⁰ Gregory, J. W., 'Is the Earth drying up?' *ibid.* XLIII (1914), p. 232. See also correspondence, p. 451.

²¹ Aerial photographs taken on the Makran coast of south-western Baluchistan show in a remarkable manner the erosive effects of the sudden cloudburst in an arid climate.

²² Blanford, W. T., 'On the Nature and probable Origin of the superficial Deposits in the Valleys and Deserts of Central Persia.' *Q. Journ. Geol. Soc.*, XXIX, 1873, p. 493.

to the Aral and Caspian Seas, and that they indicate the great desiccation the country has experienced.

The huge mass of Arabia is probably less arid than is commonly supposed, especially round the coasts, but the southern half of the peninsula is in large measure a sand desert. The desert of northern Arabia is continued by the great Syrian desert which passes on the west into the arid plateau of Moab and Edom and on the east is bordered by Mesopotamia (Iraq) where the sites of numerous cities of the past from Nineveh in the north to Babylon in the south are now semi-desert.

Judaea is in the main an arid plateau, and the Wilderness of Judaea (Pl. 2 A) may well be termed desert. Southward from Beersheba to the head of the Gulf of Akaba the country is mainly of a thoroughly desert character.

North African Deserts

The most extensive and possibly the most thoroughly studied deserts of the world are those of North Africa which are commonly grouped under the comprehensive name of the Sahara.

In addition to the full account by Hume in his *Geology of Egypt*, the literature includes a series of important memoirs by him and other officers of the Egyptian Geological Survey, the classical memoirs of Zittel²³ and of Walther, and for the western region those by the French geographers especially Gautier.²⁴

The prevalent idea that the Sahara consists of a waste of sand is due to the fact that sand predominates in the N., W., and E., the directions from which it is usually approached, while in the centre, rocky plateaux are far more prevalent.

The Sahara includes several types of surface :—

- (1) The Sand desert (*erg*) represented by the great Libyan desert west of the Nile where are found the great oases, and by much of the western Sahara where the sand is drifted eastwards by the trade winds.
- (2) The plateau desert or hammada, largely limestone.
- (3) The mountain desert further west which rises to a greater height than any other part and is largely composed of metamorphic and of

²³ Zittel, K. A., 'Beiträge zur Geologie und Paläontologie der Lybischen Wüste . . .', Cassel, 1883. Reviewed *Nature* XXIX (Nov., 1883 to April, 1884), p. 121.

²⁴ E. F. Gautier, trans. by D. F. Mayhew (1905) '*Sahara, the Great Desert.*'

igneous rocks, both plutonic and volcanic, the latter including remarkable volcanic necks of Tertiary date. Its mean altitude is probably not less than 2,000 feet in spite of the fact that a large area lying south of Algeria is below sea-level.

East of the Nile comes a limestone plateau, and finally the highly rugged mountain region of the eastern desert of which Sinai is a continuation. This consists partly of sedimentary, partly of igneous and metamorphic rocks. The region E. of the Nile has a greater rainfall than that to the W. and the evidence for erosion by running water is clear.

The Libyan desert, like all true deserts, is an area of internal drainage, and there are large areas below sea-level such as the great Siwa depression, 500 miles S.W. of Cairo, of which the deepest part is 134 metres below sea-level. The prevalent opinion is that these depressions owe their origin mainly to the wearing action of wind-borne sand. In the desert of the north-western Soudan and southern Libya, the occurrence of great numbers of stone implements at certain oases points to the former more habitable character of the country. The former existence of lakes with a fresh water fauna, but now completely dried up, also points to increasing aridity. Desert conditions seem to be extending southwards from the Sahara towards both the Soudan and Nigeria. 'This is not due to climatic causes but to human agency. A piece of forest is cut down, the timber burnt, and the ground cultivated. When the crops deteriorate, the patch is abandoned and a new one occupied. Thus scrub replaces forest and is further destroyed by shepherds who, when the fodder value has almost gone, cut the remaining wood for goats. This is the last stage in the ruination of the land and advance of the desert.'

South African Deserts

While in S.W. Africa much of the country is true desert, the greater part, including the Karroo and the Kalahari, while very dry and with much of the vegetation of a succulent drought-resisting type, does not merit the term desert. Passarge's memoir on the Kalahari is the classical work on South African arid lands; he attached special importance to planation due to wind action.

A commission appointed to investigate the alleged desiccation of S. Africa reported that while the conditions are much worse than when the country was first settled, there is no evidence that the mean annual rainfall has changed in historic times. The deterioration is due to ill-

judged human action. The kraaling of sheep to protect them from wild animals has led to the local destruction of vegetation and the reduction of the soil to dust followed by its sweeping away by the wind. As a result, the rain, instead of sinking quietly in, gathers into water courses which rapidly become enlarged into deep ravines. Such erosion (Pl. 6 A) when once started, tends to go on at an ever increasing rate and has led to the great reduction or even destruction of many of the grass flats or vleis of former times.²⁵

This is not the only damage caused, for in the mountain region of the Cape Province, streams which formerly gave a steady supply of water have been so changed by the destruction of the vegetation in the catchment area that, while for much of the year they are dry, for part they form destructive mountain torrents which may smother fertile land with gravel and sand.

The Karroo beds (Pl. 6 B) (Upper Carboniferous to Trias), which cover such a large part of S. Africa, point to an arid climate, being largely flood-plain deposits modified by wind action. The remarkable Karroo reptiles were terrestrial and probably of desert type. (Watson, D. M. S., *Geol. Mag.*, 1913, p. 391.)

North American Deserts

The desert areas of the American Union are in large measure rather of the nature of steppes than unmitigated deserts such as those of Libya and Chili. Their most remarkable feature is afforded by the great basin-like depressions which they contain. These include the Mojave basin and the 'Death valley' of California, but the most famous areas are those of 'Lake Bonneville' in Utah and Lake Lahontan in Nevada, described in the classical memoirs of Gilbert²⁶ and Russell²⁷ respectively. Both are areas of internal drainage and still contain permanent lakes, the Great Salt Lake of Utah, the remnant of Lake Bonneville, and the Pyramid Lake, a remnant of Lake Lahontan. In other cases it is only in time of flood that water remains in the centre of the basin when temporary lakes or playas may be found. The 'Death Valley' of California is also the site of a dried-up lake.

In southern New Mexico and northern Texas large depressions known as bolsons are found; they were probably hollowed out by wind action.

²⁵ Kanthack, F. E., 'Alleged desiccation of South Africa,' *Geog. Journ.*, LXXVI, 1930, p. 516.

²⁶ Gilbert, G. K., 'Lake Bonneville,' *U.S. Geol. Surv. Monographs*, 1890.

²⁷ Russell, I. C., 'Lake Lahontan,' *ibid.*, 1885.

Two general types of vegetation²⁸ have been recognized in North American arid lands, a southern type characterized by cacti and mesquite (*Prosopis*), typically seen in Arizona, and a northern type comparable with that of the arid lands of the Mediterranean region, well seen in Utah, and characterized by Sage Bush (*Artemisia*). (Pl. 3 B.)

South American Deserts

The chief deserts of South America are those west of the Andes in northern Chili and Peru. The Chilian desert is mainly sandy and almost devoid of vegetation, except where it is crossed at intervals by fertile valleys occupied by rivers flowing from the Andes. The Chilian desert has great economic importance owing to the deposits of nitrate of soda, borates and other substances which testify to its extreme rainlessness.

The desert of Tumbe in northern Peru is fully described with a long series of fine plates by Bosworth.²⁹ While normally absolutely rainless, two or three times in a century the desert is swept by tremendous floods, producing great fans of debris at the foot of the mountains.

The Argentine includes the desolate arid steppes of Patagonia.

Australian Deserts

Western Australia and the northern part of South Australia are of an arid character but, as Griffith Taylor points out, very little of the country has less than 5 inches of rain in the year and is scarcely to be regarded as true desert; there is little country formed, like so much of the Sahara, of great wastes of sand (*erg*). Much of the surface is rocky and approaches the North African desert pavement (*hammada*), more still is thickly strewn with rock-debris and gravel and approaches the North African *serir*.

Penck, alluding to the Kalgourlie district of Western Australia, remarked that, as regards the lack of water, it has all the characters of a true desert, but is well wooded. In other parts of Western Australia

²⁸ Macdougall, D. T., 'North American Deserts,' *Geog. Journ.*, XXXIX (1912), p. 105, has a very fine series of plates showing the vegetation.

A paper by T. O. Bosworth on 'Semi-arid conditions in part of Southern Texas,' *Geol. Mag.*, 1913, p. 481, contains an account (with plate) of the vegetation.

²⁹ Bosworth, T. O., *Geology of . . . North-West Peru* . . . 1922. Remarkable photographs are given of 'sun-sliced' pebbles, and of 'splinter sand,' consisting of particles of pebbles reduced by sun-splitting and wind-cutting to such small size that they are drifted away by the wind. There are also good plates of the vegetation.

the surface may be sparsely covered with *Acacia*, with dwarf *Eucalyptus* or with *Spinifex*.

Lake basins with no outlet, and commonly dry for most of the year, are characteristic. The most noted of these is Lake Eyre which formerly had three times its present size and was fresh. Gregory describes the stony plains near Lake Eyre; the material was at first thought to be water-worn shingle but, according to Gregory, the 'pebbles' are due to the rounding by wind action of fragments of a bed of hard sandstone.

Woolnough³⁰ describes the chemical weathering which occurs in large parts of South Australia where there is little rain and very sluggish run off. He compares these conditions with those of Europe in Old Red Sandstone and Permo-triassic times.

Oases

Oases are due to many causes and may vary in size almost indefinitely. As regards causes:

(1) In the case of the great Egyptian oases in the Libyan desert W. of the Nile, the Kharga, Dackla, Bahariya and Farafra oases, the water is derived from artesian wells as is the case in many of the oases of Algeria and elsewhere.

(2) The Damascus oasis, doubtless the most famous in history, is situated near where the Abana and Pharphar flow out from the Anti-Lebanon. The water is conducted through the great city in a series of channels and some 18 miles beyond its limits the rivers lose themselves in a swamp.

(3) The Jericho oasis (Pl. 5 B) depends partly on the Wady Kelt, which flows out from the Wilderness of Judaea near by, partly on the powerful spring known as Elisha's fountain. Many oases in central Asia, on the Pacific coast of S. America and in numerous other instances are situated at the outflow of a mountain stream which a short distance further on loses itself in the desert.

(4) Some large and innumerable small oases are due to springs. An instance of a large oasis due to this cause is that of Hasa in Arabia which has numerous springs, some so powerful that water can be drawn off for irrigation purposes.

The great oases of the Libyan desert are depressions worn through the

³⁰ Woolnough, W. G., 'The Influence of Climate and Topography in the formation and distribution of the Products of Weathering,' *Geol. Mag.*, LXVII (1930), p. 123.

Eocene and Upper Cretaceous rocks to the Nubian sandstone below. As regards the origin of these great depressions, Hume considered that the erosion was partly marine and took place during the upheaval of the Tertiary rocks, partly due to wind. Walther would attribute the whole to wind action, in which conclusion he is supported by many later writers.

As regards the source of the water tapped by the artesian wells of the Libyan desert, it has been suggested that it has percolated through from the Nile. Passarge has maintained that there was a pluvial period in N. Africa corresponding to the glacial period further north, and that many of the artesian wells in the oases of Algeria and other parts of N. Africa are drawing on stores of water accumulated during this period.

Numerous oases owe their survival to human action, and when man's control is removed the vegetation tends to die out quickly. On the other hand there are potential oases in many dry river beds when the water-table is not too low.

In some parts of the northern Sahara, where the French have introduced irrigation by means of artesian wells, the deposition of surface salt has made it necessary to abandon the enterprise.

The writer wishes to thank Dr. S. W. Wooldridge for kindly reading the script.

The cost of illustrations has been in part defrayed by a grant from the University of Bristol Colston Society.

The plates are all from photographs by the writer except in the cases of Plates 4 B and 6 A, for the use of which the writer wishes heartily to thank Dr. G. W. Grabham and Mr. and Mrs. Bancroft Clark respectively.

The Algæ of Four Somersetshire Pools

By AUDRIE E. FITZJOHN, M.Sc.

(Read in title, 2nd March, 1940)

SINCE 1938, observations have been made on the algal vegetation of four pools in Somersetshire:—the Fish Ponds at Abbots Leigh, Hunstrete near Bristol, and Prior Park, Bath, and Batheaston Reservoir, near Bath. With the exception of the publication by Fritsch and Rich (*Proc. B.N.S.*, 1908, Vol. II, p. 27) on the algæ of the Fish Pond, Abbots Leigh, no lists for algæ of the district have been published.

Collections were made at monthly intervals during 1939 with a fine silk plankton net, and samples of water collected in bottles were centrifuged, so that actual counts could be made of the frequency of each organism. This work is still in progress, but it has been suggested by Professor M. Skene that a list should be published of algæ already identified. I would like to thank Professor M. Skene for the help he has given me, also Dr. E. M. Lind of Sheffield for help in identification, Mr. J. Thornley (Water Engineer at Bath) and others for giving me facilities to take samples.

The following is a list of algæ found:—

A = Fish Pond, Abbots Leigh.

B = Batheaston Reservoir, Bath Corporation Waterworks.

H = Fish Pond, Hunstrete.

P = Fish Pond, Prior Park.

VOLVOCALES :

Chlamydomonas spp. A.B.H.P.
Pandorina morum Bory. A.H.P.
Eudorina elegans Ehrenb. A.H.P.
Volvox aureus Ehrenb. A.
Phacotus lenticularis Stein. A.
Pteromonas aculeata Lemm. H.
Tetraspora gelatinosa Desv. H.

CHLOROCOCCALES :

Pediastrum Boryanum Menegh. A.B.H.P.
Pediastrum duplex Meyen. H.
Pediastrum tetras Ralfs. H.
Micractinium radiatum Wille. H.
Chodatella ciliata Lemm. H.
Tetraëdron caudatum Hansg. H.
Tetraëdron minimum Hansg. A.B.H.P.
Tetraëdron sp. H.
Ankistrodesmus falcatus Ralfs. A.H.P.
Ankistrodesmus setigerus G. S. West. A.
Actinastrum hantzschii Lagerh. H.
Kirchneriella obesa Schmidle. H.

Westella botryoides De Wildem. H.
Crucigenia minima Brunnth. H.
Crucigenia rectangularis Gay. H.
Crucigenia Tetrapedia W. & G. S. West. H.
Tetrastrum Staurigeniaeforme Chod. H.
Scenedesmus bijuga Lagerh. B.
Scenedesmus obliquus Kütz. A.H.
Scenedesmus quadricauda Bréb. A.B.H.P.
Scenedesmus quadricauda var. *horridus* Kirchn. H.
Coelastrum sphaericum Naeg. A.H.P.

ULOTRICHALES : *Ulothrix aequalis* Kütz. A.
Ulothrix subtilis Kütz. A.
Ulothrix zonata Kütz. A.
Ulothrix sp. A.B.
Enteromorpha intestinalis Link. P.
Rhizoclonium hieroglyphicum Kütz. A.H.P.
Cladophora fracta Kütz. A.
Cladophora sp. B.H.P.

CHAETOPHORALES : *Aphanochaete repens* A.Br. A.

OEDOGONIALES : *Oedogonium* spp. A.B.H.P.
Bulbochaete sp. P.

CONJUGATAE : *Zygnema* sp. B.P.
Spirogyra spp. A.B.H.P.
Mougeotia spp. A.B.H.P.
Closterium acerosum Ehrenb. H.P.
Closterium Ehrenbergii Menegh. A.
Closterium Leibleinii Kütz. P.
Closterium parvulum Naeg. P.
Closterium peracerosum Gay. P.
Closterium pronum Bréb. H.P.
Closterium strigosum Bréb. A.
Cosmarium Botrytis Menegh. A.P.
Cosmarium granatum Bréb. P.
Cosmarium Phaseolus Bréb. H.
Cosmarium praemorsum Bréb. B.H.P.
Cosmarium subtumidum Nordst. B.
Cosmarium venustum Bréb. P.
Staurastrum paradoxum Meyen. H.
Hyalotheca dissiliens Bréb.

SIPHONALES : *Vaucheria* sp. A.

HETEROCOCCALES : *Characiopsis Naegelii* Lemm. H.

HETEROTRICHALES : *Tribonema affine* G. S. West. A.

CHRYSTOPHYCEAE : *Uroglena* sp. B.P.
Dinobryon divergens Imhof. A.B.P.

BACILLARIALES : *Melosira granulata* Ralfs. A.H.P.
Melosira varians Ag. A.B.H.P.
Cyclotella meneghiniana Kütz. (Small form) A.
Cyclotella operculata Kütz. A.B.H.P.
Meridion circulare Ag. B.
Diatoma elongatum Ag. A.P.
Diatoma vulgare Bory. A.B.P.
Fragilaria capucina Desmaz. P.
Fragilaria mutabilis Grun. A.B.H.P.

Fragilaria virescens Ralfs. A.B.H.
Synedra acus Grun. A.B.H.P.
Synedra acus var. *radians* Hust. A.B.H.P.
Synedra capitata Ehrenb. H.P.
Synedra ulna Ehrenb. A.B.H.P.
Asterionella formosa Hass. A.B.
Eunotia lunaris Grun. A.
Eunotia pectinalis Rabenh. P.
Achnanthes coarctica Bréb. P.
Achnanthes flexella Bréb. B.P.
Achnanthes linearis W. Sm. A.B.H.P.
Cocconeis pediculus Ehrenb. A.H.
Rhoicosphenia curvata Grun. A.H.
Navicula gibba Ehrenb. A.H.P.
Navicula gracilis Ehrenb. B.
Navicula major Kütz. A.H.
Navicula nobilis Ehrenb. A.H.
Navicula radiosa Kütz. A.B.H.P.
Navicula sphaerophora Kütz. A.
Navicula viridis Kütz. H.
Navicula spp. A.B.H.P.
Stauroneis phoenicenteron Ehrenb. A.
Gyrosigma acuminatum Kütz. A.
Gyrosigma attenuatum Rabenh. H.
Gomphonema constrictum Ehrenb. A.B.H.P.
Gomphonema parvulum Kütz. A.B.
Cymbella caespitosa Kütz. A. H.
Cymbella Cistula Hemp. P.
Cymbella cymbiformis Ehrenb. B.P.
Cymbella Ehrenbergii Kütz. H.
Cymbella lanceolata Ehrenb. A.B.H.P.
Cymbella prostrata Berk. A.H.
Amphora ovalis Kütz. A.H.
Epithemia Argus Kütz. A.B.H.
Epithemia turgida Kütz. A.
Nitzschia acicularis W. Sm. A.H.P.
Nitzschia amphibia Grun. P.
Nitzschia linearis W. Sm. A.B.H.P.
Nitzschia palea Kütz. A.B.H.P.
Nitzschia sigmoidea W. Sm. A.H.P.
Nitzschia sp. H.
Cymatopleura elliptica W. Sm. A.
Cymatopleura Solea W. Sm. A.H.
Surirella ovalis Bréb. H.
Surirella robusta Ehrenb. H.
Surirella robusta var. *splendida* V. H. A.H.

CRYPTOPHYCEAE : *Cryptomonas ovata* Ehrenb. A.H.P.

DINOPHYCEAE : *Gymnodinium paradoxum* Schilling. B.
Glenodinium pulvisculus Stein. P.
Glenodinium uliginosum Schilling. A.H.P.
Peridinium cinctum Ehrenb. H.P.
Peridinium inconspicuum Lemm. B.
Ceratium hirundinella O. F. M. A.B.P.

EUGLENINEAE : *Euglena acus* Ehrenb. A.
Euglena oxyuris Schmarda. H.
Euglena spirogyra Ehrenb. H.
Euglena sp. A.P.
Phacus longicauda Duj. A.H.P.
Phacus pleuronectes Duj. H.

Phacus pyrum Stein. P.
Trachelomonas hispida Stein. A.B.H.P.
Trachelomonas volvocina Ehrenb. A.B.H.P.

RHODOPHYCEAE : *Batrachospermum moniliforme* Roth. B.

MYXOPHYCEAE : *Merismopedia glauca* Naeg. B.
Coelosphaerium Naegelianum Unger. A.H.
Microcystis aeruginosa Kütz. A.H.P.
Chroococcus minor Naeg. B.
Chroococcus sp. H.
Oscillatoria brevis Kütz. B.
Oscillatoria limosa Ag. A.H.P.
Oscillatoria proboscoidea Gom. H.P.
Oscillatoria tenuis Ag. A.B.H.P.
Oscillatoria spp. P.
Phormidium tenue Gom. B.P.
Lyngbya aerugineo-coerulea Gom. A.B.H.P.
Lyngbya major Menegh. B.
Anabaena circinalis Hansg. A.
Anabaena flos-aquae Bréb. A.
Anabaena Lemmermanni P. Richter. H.
Aphanizomenon flos-aquae Ralfs. A.H.

Acknowledgments are due to the Colston Research Society of the University of Bristol for assistance in defraying the cost of publication of this paper.

On a Recent Boring Reaching the Coal Measures at Chew Stoke, Nr. Bristol

By L. R. MOORE, B.Sc., PH.D., F.G.S.

THIS boring was commenced for the purpose of locating water supplies, and examination of the core, which was carefully preserved, has resulted in important additional knowledge of the extent of the Bristol Coalfield, which is given below.

The Boring at Chew Stoke

A series of trial pits and two deeper borings were made by the Bristol Waterworks Company in order to ascertain the structure of the neighbourhood.

The writer is indebted to the Company and especially to Mr. Melvin, their assistant engineer, for permission to examine the trial pits and in particular the deeper section afforded by the borehole core.

Professor Trueman drew my attention to the boring, and has kindly examined the fossil shells found therein. To Dr. Wallis I am indebted for the arrangements he made concerning the inspection and breaking up of the core.

The site of the deeper boring "A" lies on the right bank of the River Chew, near Walley Court, and about one mile east of Chew Stoke.

Boring commenced in red Keuper Marl and passed into Coal Measures, reaching a total depth of 105 feet. The core, though weathered when examined, had been very carefully laid out and accurately measured by the engineers.

The section of the deeper boring "A" is given below:—

SECTION.

TRIAS.	Thickness		Depth.	
	Feet		Feet	
Red Keuper Marl with green mottled bands	..	25	..	25
Keuper Marl—green and red mottled	..	5	..	30
Hard and coarse-grained sandstones		5	..	35
Softer sandstone		5	..	40
Hard grey sandstone		6	..	46

COAL MEASURES.

Micaceous grey shales passing down to—	4	50
Hard coarsely-grained quartzite	20	70
Softer arenaceous shale with thin quartzite bands ..	10	80
Light blue arenaceous shale with plant remains ..	5	85
Light blue shale with fragmentary plants	3	88
Dark blue shale with calcite streaks—(a thin band at 90 feet rich in non-marine lamellibranchs) ..	2	90
Light blue arenaceous shale	10	100
Dark shales, black carbonaceous shale and thin coal streaks at 104 feet, fragmentary remains of <i>Cordaites</i> and <i>Sigillaria</i>	5	105

The occurrence of distinct hard bands of sandstone near the base of the thin section of Trias is interesting. Some bands of this sandstone bear strong lithological resemblance to the "Pennant" sandstones of the Bristol Coalfield. A similar base to the Trias has been observed near Pensford and Bromley.

The Coal Measures are particularly important since they yielded between 80—85 feet a valuable collection of fossil plants, whilst at 90 feet a non-marine horizon was discovered yielding specimens of *Naiadites* sp.

The following plants were obtained :—

<i>Sphenopteris pseudo-furcata</i>	Kidston
<i>Neuropteris</i> cf. <i>callosa</i>	Jongmans and Gothan
<i>Asterotheca miltoni</i>	(Artis)
<i>Sphenophyllum myriophyllum</i>	Crèpin
<i>Sphenophyllum majus</i>	Bronn
<i>Lepidophyllum triangularis</i>	Zeiller
<i>Sigillaria</i> sp.	
<i>Calamites carinatus</i>	Sternberg

The horizon represented by the above collective evidence of both flora and fauna lies within the Lower Coal Series and it is thought to lie within the Similis-Pulchra Zone of the Coalfield.

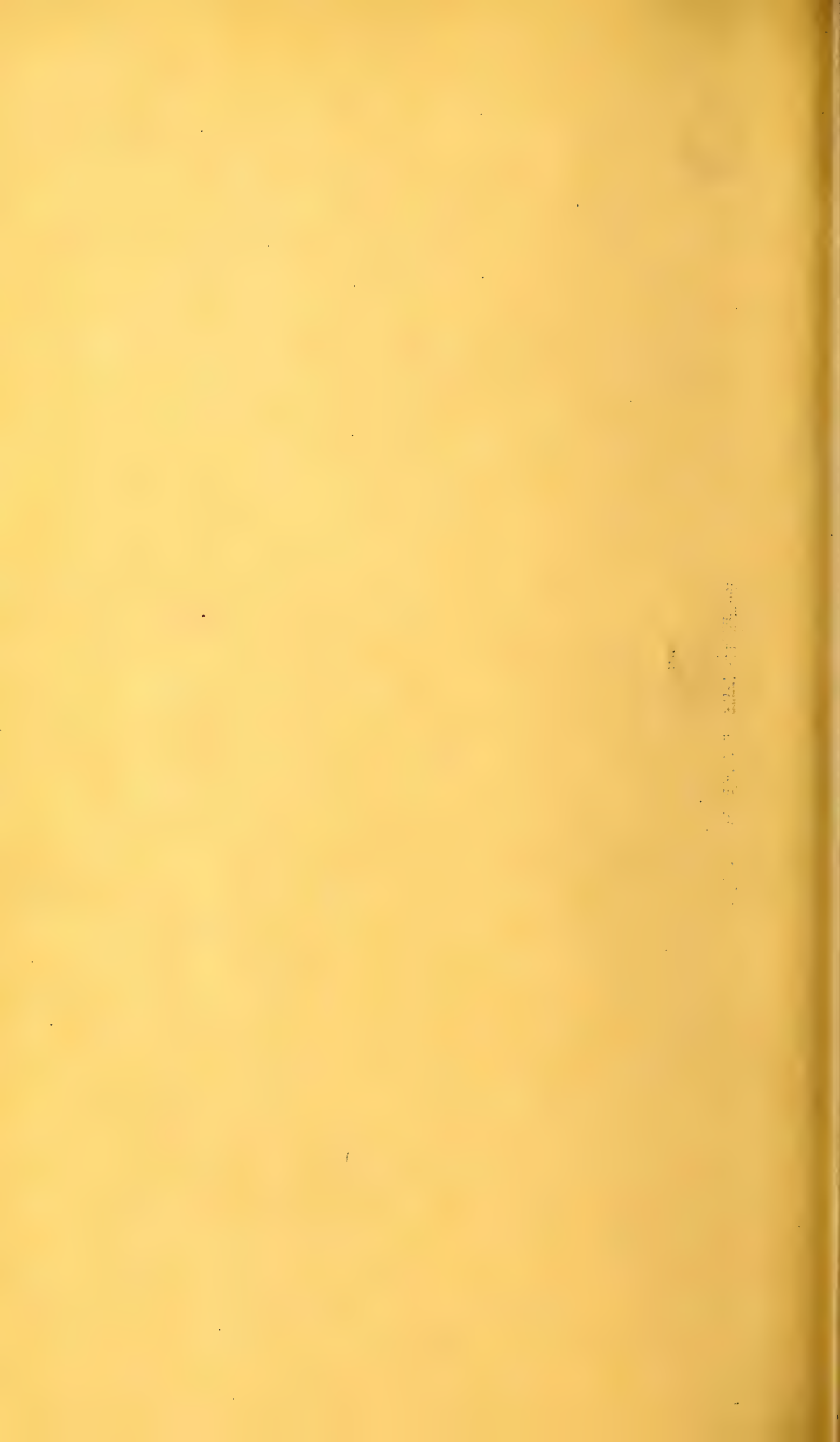
The occurrence of *Sphenopteris pseudo-furcata* Kidston is interesting. Dr. E. Dix has kindly identified this species and points out that hitherto it has only been recorded by Kidston from the roof of the Bensham Seam, near the base of the Similis-Pulchra Zone, of the Durham Coalfield. It has been pointed out (Moore and Trueman, 1937) that the extensively worked Great Vein of the Kingswood area of the Bristol Coalfield is thought to lie near the base of the Similis-Pulchra Zone. It is therefore probable that, at no great depth below the surface, workable coals may underlie some part of the Chew Stoke area.

The dips observed in the Coal Measures were not usually high though

the trial pits proved the presence of an east-west trending fault affecting the Trias. This fault may be related to a larger fault in the Coal Measures, and its presence in the Trias might be ascribed to subsequent movement along this older line of faulting. Such a fault, trending in an eastward direction towards Chew Stoke, has been encountered in the Coal Measures at Pensford (Moore and Trueman, 1939) to the east of the present area under consideration.

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"Rerum cognoscere causas."—Virgil.

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A.	Cornish, Miss G. A.	51 Chesterfield Road, Bristol, 6	
	Cratchley, Rev. W. J., Ph.D., M.A., B.Sc., F.C.S.	St. John's Vicarage, Apsley Road, Clifton, Bristol, 8	
A.	Crofton, Miss K.	11 Holmes Grove, Henleaze, Bristol, 6	<i>O.</i>
	Cruttwell, G. H. W. (1941)	Rowden House, Frome	<i>E.</i>
+	Daniels, F. L., F.G.S.	Stringer's Court, Rodborough, Stroud, Glos.	
	Davies, T. H.	Down House, Stoke Bishop, Bristol, 9	
*	Davis, H. H., M.B.O.U. ..	Little Stoke, Patchway, near Bristol	<i>O.</i>
	Davis, Mrs.	Little Stoke, Patchway, near Bristol	<i>B.O.</i>
A.	Davis, Miss M. C.	71 Arley Hill, Bristol, 6	<i>F.</i>
A.	Davis, M. J. L.	8 Osborne Road, Clifton, Bristol, 8	<i>E.</i>
J.	Dixon, Miss M. D.	11 Pembroke Road, Clifton, Bristol, 8	<i>O.</i>
A.	Dobbin, G. M.	12 Eaton Crescent, Clifton, Bristol, 8	<i>G.</i>
	Donovan, D. T.	12 Royal Crescent, Bath	<i>G.</i>
	Druitt, C. F.	"Springfield," The Avenue, Clevedon, Som.	<i>O.</i>
	Duddridge, Miss E., B.Sc.	59 Kellaway Avenue, Bristol, 6	<i>F.O.</i>
J.	Dunn, Miss A. J.	"Cambri," Elm Park, Filton, Bristol	<i>F.</i>
A.	Dunncliff, H.	10 Effingham Road, St. Andrew's, Bristol, 6	<i>O.</i>
	Dunscombe, Miss A.	5 Westmoreland Road, Durdham Park, Bristol, 6	
	Durrant, N. J.	Cherry Copse, Camp Lane, Clapton- in-Gordano, Som.	<i>O.</i>
*	Edmonds, H. O.	33 Wellington Park, Clifton, Bristol, 8	<i>F.</i>
	Evans, I. W.	46 Horfield Road, St. Michael's, Bristol, 2	<i>B.F.</i>
	Evens, F. W., A.C.A.	St. Ives, Station Road, West Town, Somerset.	<i>B.F.</i>
	Eyres, Miss G., B.Sc.	35 Deanery Road, Warmley, nr. Bristol	<i>B.</i>
	Fear, A. C. K., B.Sc. F.R.H.S.	Lodway Road, Pill, nr. Bristol	<i>B.G.</i>
	Fermor, Sir Lewis L., O.B.E., D.Sc., F.R.S. ..	24 Durdham Park, Bristol, 6	<i>B.G.</i>
	Fermor, Lady	24 Durdham Park, Bristol, 6	<i>G.</i>

	Fitzjames, R. H.	17 St. Martin's Road, Knowle, Bristol, 4	<i>G.</i>
*	Fitzjohn, Miss A., M.Sc. ..	The Museum, Leicester	<i>B.F.</i>
	Ford, Roger	Hartfield, Cotham Park, Bristol, 6	<i>F.O.</i>
	Fox, Mrs. A.	Brislington House, near Bristol	
	Fraser, Mrs. H. G.	Foye House, Leigh Woods, Bristol	<i>O.</i>
A.	Fry, T. R.	59 Air Balloon Hill, St. George, Bristol, 5	<i>G.</i>
J.	Fursdon, G. H. J.	Wills Hall, Stoke Bishop, Bristol, 9	<i>O.</i>
	Gordon, Prof. W. T., D.Sc., F.G.S.	The University, Bristol, 8	<i>G.</i>
	Gordon-Smith, S.	Estyn, Boughton, Chester	<i>E.</i>
A.	Gorham, Major A.	Avonside, Limpley Stoke, Bath, Som.	<i>G.</i>
	Gorvett, Harold, Ph.D. ..	"Onaway," Station Road, West Town, Som.	<i>B.</i>
	Gradidge, Miss E.	23 St. John's Road, Clifton, Bristol, 8	<i>F.</i>
A.	Green, Mrs. M. B., L.L.A.	Dyrham, nr. Chippenham, Wilts.	<i>O.</i>
A.	Grignon, Miss A. E.	41 Filton Avenue, Horfield, Bristol, 7	<i>B.F.G.</i>
A.	Gunner, A.	Grammar School, Bristol	<i>G.</i>
A.	Habgood, Miss M. E.	9 Burlington Road, Redland, Bristol, 6	<i>F.</i>
	Hamilton, R. G., B.A.	1 Elgin Park, Bristol, 6	<i>O.</i>
	Hatch, R. S.	15 Hanbury Road, Clifton, Bristol, 8	<i>O.</i>
	Hayman, Mrs. E. S.	106 Pembroke Road, Clifton, Bristol, 8	<i>B.E.F.G.O</i>
	Hayward, Miss E.	31 Manor Road, Bishopston, Bristol, 7	<i>O.</i>
+	Heslop, I. R. P., M.A., F.R.E.S.	34 Henleaze Gardens, Westbury-on- Trym, Bristol	<i>E.</i>
	Hewer, Mrs. T. F.	Old Coombe Farm House, Westbury- on-Trym, Bristol	<i>O.</i>
	Hiley, Miss M. D.	9 Vyvyan Terrace, Clifton, Bristol, 8	<i>F.</i>
	Hiley, Miss W. F.	9 Vyvyan Terrace, Clifton, Bristol, 8	<i>F.</i>
A.	Hodder, Mrs. N. F.	219 Redland Road, Bristol, 6	<i>F.</i>
A.	How, J. C.	17 Wellington Park, Clifton, Bristol, 8	<i>B.G.</i>
	Howells, G. T.	43 Wellington Walk, Henleaze, Bristol, 6	
	Hudson, F. G.	The Elms, Stinchcombe, Dursley, Glos.	<i>G.</i>
	Hudson, Mrs.	The Elms, Stinchcombe, Dursley, Glos.	<i>G.</i>
A.	Hughes, Dr. Marguerite	St. Kilda's Private Hotel, Upper Belgrave Road, Bristol, 8	<i>B.</i>
	Humphries, Lady (resigned, 1941)	Eastfield Lodge, Westbury-on-Trym, Bristol	<i>O.</i>
J.	Humphries, R. A.	Auburn House, Clifton Down, Bristol, 8	<i>O.</i>
A.	Hunt, Miss L. A.	7 Alpha Road, Southville, Bristol, 3	<i>F.O.</i>
A.	Hutchinson, Miss M. I. ..	57 Oakfield Road, Clifton, Bristol, 8	<i>F.</i>
	Ivens, H. P.	18 Alexandra Road, Clifton, Bristol, 8	<i>F.</i>
	Jeffcoat, Rev. R., M.A. ..	30 Elgin Park, Redland, Bristol, 6	<i>B.E.F.G.O.</i>
	Jenkin, Miss P. M., M.A. .	The University, Bristol, 8	
	Jenkins, F. G., M.B., Ch.B.	51 Redcliff Hill, Bristol, 1	
*	Kearns, H. G. H., Ph.D., B.Sc., F.R.E.S.	The Research Station, Long Ashton, Bristol	

* Kellaway, G. A., B.Sc.....	Geological Survey and Museum, South Kensington, London, S.W.7	G.
* Kendall, O. D., M.A.	3 Old Sneed Road, Stoke Bishop, Bristol, 9	
A. King, B.	Mayfield, Uplands Road, Saltford, Bristol	B.O.
A. King, Mrs. B.	Mayfield, Uplands Road, Saltford, Bristol	O.
A. Kromler, A. A.	45 Summerlease, Fishponds, Bristol	E.
Lankshear, Miss B., B.Sc. (1941)	24b Gloucester Road, Bristol, 7	G.
* Leach, A. C., M.A.	Clifton College, Bude	O.
Leach, Mrs. A. C.	Clifton College, Bude	O.
Lewis, H. M.	"Arnwood," Lansdowne Road, Bath	O.
A. Lodge, Mrs.	5 Worcester Terrace, Clifton, Bristol, 8	B.
Macpherson, Miss B. B. ..	35 Richmond Terrace, Clifton, Bristol, 8	F.
Mappin, S. W.	100 Pembroke Road, Clifton, Bristol, 8	G.
Marsden, A., M.Sc., F.I.C.	161 Bishop Road, Bishopston, Bristol, 7	G.
Marsden, Mrs.	161 Bishop Road, Bishopston, Bristol, 7	F.G.
* Matthews, L. H., M.A. Sc.D.	27 Hanbury Road, Clifton, Bristol, 8	O.
Maunder, G. S., B.Sc.	Newhaven, Moor Lane, Station Rd., West Town, Bristol	B.F.G.
Maxwell, H. W.	10A Downfield Road, Clifton, Bristol, 8	F.O.
Maxwell, Mrs.	10A Downfield Road, Clifton, Bristol, 8	F.
* McMurtrie, G. E. J.	Eastfield House, Westbury-on-Trym, Bristol	F.G.
McMurtrie, Mrs.	Eastfield House, Westbury-on-Trym, Bristol	F.
Mead, Miss C. E., B.A.	16 Quadrant West, Hillfields Park, Bristol	F.G.
Milton, Mrs. I. C.	10 Randall Road, Bristol, 8	F.O.
A. Mogford, C. J.	13 Park Grove, Westbury Park, Bristol, 6	F.G.
A.* Mogg, G.	483 Fishponds Road, Bristol, 5	F.O.
* Moore, L. R., B.Sc., Ph.D., F.G.S.	University College, Newport Road, Cardiff	
A. Morrison, Miss A. M. C. ..	8 Richmond Hill, Clifton, Bristol, 8	F.O.
Morrison, Miss E. J. D., M.A.	6 Greenway Road, Redland, Bristol, 6	F.
A. Neal, H. W.	70 Trymside, Sea Mills, Bristol, 9	O.
A. Nettle, Miss E. C.	3 Beaufort Road, Kingswood, Bristol	F.
Norgrove, J. W.	22 Alma Road, Clifton, Bristol, 8	E.
A. Organ, Miss Lilian	11 Trelawney Road, Clifton, Bristol, 8	F.
J. Paddon, C. J.	24 Wanscon Walk, Westbury-on- Trym, Bristol	O.
Payne, T. H.	Compton House, Chew Stoke, nr. Bristol	
* Peach, A. H.	5 Hanbury Road, Clifton, Bristol, 8	E.O.

* Pearman, J. V., F.R.E.S. . . .	56 Clifton Park Road, Clifton, Bristol, 8	<i>E.</i>
A. Pedler, H. H.	21 Clift Road, Ashton Gate, Bristol, 3.	<i>G.</i>
A. Peregrine, Miss G. H., B.Sc. (1941)	The University, Bristol, 8	<i>G.</i>
Phillips, M. M. (resigned, 1940)	47 New Fosseway Road, Whitchurch, Bristol, 4	<i>G.</i>
Piper, Miss F. M.	East Harptree, nr. Bristol	
A. Potter, Miss E. A.	Westonbirt School, near Tetbury, Glos.	<i>O.</i>
Powell, J. J., M.D.	18 Elgin Park, Redland, Bristol, 6	<i>G.</i>
A. Pratt, Miss D. L.	1 Hughenden Road, Clifton, Bristol, 8	<i>B.F.</i>
* Purchon, R. D., B.Sc., Ph.D.	c/o Clouds Hill House, St. George, Bristol, 5	<i>O.</i>
A. Race, Miss E. M.	16 Upper Belgrave Road, Clifton, Bristol, 8	<i>F.</i>
* Rafter, J., M.A.	228 Shirehampton Road, Westbury-on-Trym, Bristol	
Reed, F. N.	18 Stackpool Road, Southville, Bristol, 3	<i>B.F.G.</i>
Reed, W. N.	18 Stackpool Road, Southville, Bristol, 3	<i>F.G.</i>
* Reynolds, Prof. S. H., M.A., Sc.D., F.G.S.	13 All Saints' Road, Clifton, Bristol, 8	<i>G.O.</i>
Richards, G.	15 St. Aubyn's Avenue, Weston-super-Mare	<i>F.G.</i>
Ross, F. Stenhouse	25 Tugela Road, Uplands Estate, Bristol, 3	<i>G.</i>
Ross, James, M.A., F.L.A.	Central Library, Bristol, 1	
Rowley, G. D.	2 Edon Road, Westbury Park, Bristol	<i>B.E.</i>
Rowntree, N. A. F., B.Sc.	Ashcombe, Cleeve Lodge Road, Downend, Bristol	<i>G.</i>
Rutter, Miss E. M.	32 Henleaze Gardens, Bristol, 9	<i>B.</i>
St. John, Miss E., M.A. . .	19 Down Cote View, Bristol, 9	
A. Salmond, P. W.	22 Tyndall's Park Road, Clifton, Bristol, 8	<i>F.G.</i>
Salter, Miss J. E. R., B.A.	74 Reading Road, Woking, Berks.	<i>B.</i>
* Sandwith, Mrs.	26 Canynge Square, Clifton, Bristol, 8	<i>B.E.</i>
A. Saunders, Miss C. E.	25 Robertson Road, Eastville, Bristol, 5	
Savory, J. H.	Windyridge, Abbots Leigh, near Bristol	<i>O.</i>
Savory, Mrs. J. H. (1941)	Windyridge, Abbots Leigh, near Bristol	<i>O.</i>
+ Scase, R. P.	Lower Northend Farm, Batheaston, Bath.	<i>B.</i>
* Shaw, Miss T.	12c Kingsdown Parade, Bristol, 6	<i>B.F.G.</i>
Shearer, Miss O. M.	15 Abbotsford Road, Redland, Bristol, 6	<i>F.O.</i>
Shilstone, H. C.	124 Victoria Avenue, Redfield, Bristol, 5	<i>F.G.</i>
J. Simister, J. M.	4 Hillgrove, Henleaze, Bristol	<i>O.</i>
A. Simmons, Miss L., L.R.A.M.	47 Grosvenor Road, St. Paul's, Bristol, 2	<i>F.O.</i>
* Skene, Prof. Macgregor, D.Sc., F.L.S.	The University, Bristol, 8	<i>B.F.</i>

	Skene, Mrs.....	36 Lawrence Grove, Westbury-on-Trym, Bristol	
	Smith, D. Munro, M.R.C.S., L.R.C.P.	Norfolk House, Overnhill Road, Downend, near Bristol	B.O.
J.	Smith, P. G. Munro	Norfolk House, Overnhill Road, Downend, near Bristol	B.O.
A.	Smith, Miss M. de Lattre ..	The School House, High Ham, Taunton, Som.	G.
*	Smith, Stanley, M.A., D.Sc., F.G.S.	The University, Bristol, 8	G.
A.	Stanhope, Rev. A. J.	"Jesmond," 182 Bishop Road, Bristol, 7	F.G.
A.	Stocqueler, Miss A. G. S. ...	8 Alma Vale Road, Clifton, Bristol, 8	F.O.
	Studer, J. P., B.Sc.	44 Clifton Park Road, Bristol, 8	G.
	Taylor, Miss M., D.Sc.	The University, Bristol, 8	O.
A.	Taylor, R. J.	12 Claremont Avenue, Bishopston, Bristol, 7	F.
	Taylor, W. R., M.A.	Clifton College, Bude	O.
*	Tetley, H., B.Sc., F.Z.S. ...	4 The Avenue, Sneyd Park, Bristol, 9	E.O.
	Tetley, Mrs.	4 The Avenue, Sneyd Park, Bristol, 9	O.
A.	Thomas, Richard	131 Cumberland Road, Redcliff, Bristol, 1	G.
	Tovey, P. M.	12 Woodfield Road, Redland, Bristol, 6	F.
J.	Trenerry, G. G.	Windover, 54 Kellaway Avenue, Bristol, 6	O.
*	Trueman, Prof. A. E., D.Sc., F.R.S.E., F.G.S.	The University, Glasgow	G.
	Trueman, Mrs. A. E.	c/o The University, Glasgow	G.
	Tucker, B. W., M.A. M.B.O.U.	9 Marston Ferry Road, Oxford	O.
	Turner, H. W., M.A., F.G.S.	The University, Bristol, 8	G.
	Turner, Mrs. H. W.	The Cottage, Kensington Place, Clifton, Bristol, 8	
A.	Verhey, Miss D.E., B.Sc. ...	Stanmore House, Royal Crescent, Weston-super-Mare	B.
*	Wallis, F. S., D.Sc., Ph.D., F.G.S.	The Museum and Art Gallery, Bristol, 8	F.G.
A.	Walsh, Miss C. L. B.	8 Alma Vale Road, Clifton, Bristol, 8	F.
	Wareham, Miss F.	252 Charlton Road, Kingswood, Bristol	O.
	Webb, H. M., B.Sc.	Redgarth, Church Road, Stoke Bishop, Bristol, 9	G.O.
	Webb, Mrs. H. M.	Redgarth, Church Road, Stoke Bishop, Bristol, 9	O.
	Webb, H. Vicars	58 Belmont Road, St. Andrew's, Bristol, 6	F.O.
	Weir, Mrs.	Hursley Hill, Whitechurch, nr. Bristol	O.
J.	Weir, D. A.	Hursley Hill, Whitechurch, nr. Bristol	O.
	Weir, G. M.	Hursley Hill, Whitechurch, nr. Bristol	O.
*	Welch, F. B. A., B.Sc., Ph.D., F.G.S.	H.M. Geological Survey, South Kensington, S.W.7.	G.
	Wells, A. K. D.Sc., F.G.S.	25 Cooper Road, Westbury-on-Trym, Bristol	G.
	Weston, F. J.	The Tynings, Chew Stoke, nr. Bristol	
A.	Wethered, Miss D. M., M.A.	41 Canynge Road, Bristol, 8	
	Wheeler, Miss K. E.	Hillside, Watchet, Som.	
	Whittard, Prof. W. F., D.Sc., Ph.D., F.G.S.	The University, Bristol, 8	G.

	Williams, Mrs.	11 Vyvyan Terrace, Clifton, Bristol, 8	<i>F.</i>
	Williams, Miss M. E.	2 Rockleaze Avenue, Stoke Bishop, Bristol, 9	<i>F.O.</i>
+	Wills, W. Melville (deceased Jan. 26, 1941)	Bracken Hill, Leigh Woods, Bristol	
<i>J.</i>	Yeatman, John	45 Downs Cote Road, Westbury-on- Trym, Bristol	<i>F.</i>
*	Yonge, Prof. C. M., D.Sc...	The University, Bristol, 8	

* * * *

Honorary Members

- R. M. Prideaux, F.R.E.S., Brasted Chart, near Sevenoaks, Kent.
 Prof. H. S. Hele Shaw, M.I.C.E., LL.D., F.R.S., (Deceased Jan. 30, 1941)
 Sir Ernest Cook, D.Sc., 40 Alma Road, Clifton, Bristol, 8.
 H. Womersley, F.R.E.S., A.L.S., 36 Wattle Street, Fullerton Estate, Adelaide,
 S. Australia.
 A. Selley, 116, Coronation Road, Bristol, 3
 J. W. Tutchter M.Sc., 57 Berkeley Road, Bishopston, Bristol, 7.
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REPORT OF COUNCIL

1940

NOTWITHSTANDING the exceptional war conditions which have existed in Bristol during 1940, and especially during the first half of the winter session, 1940-1941, your Council is happy to report that the Society has been able to function although in a modified form. The Officers were re-elected with the exception that Miss M. D. Hiley became Hon. Secretary in place of Mr. Stenhouse Ross, who felt compelled to resign owing to pressure of other duties. Council would wish to place on record their appreciation of his services during the past three years. Miss A. E. Fitzjohn, who had been elected Assistant Secretary, subsequently resigned owing to her acceptance of a post in Leicester. Mr. Ivor Evans was elected Vice-President and new members of Council were Misses E. M. Rutter and E. St. John and Mr. J. H. Savory.

Unfortunately the Biology Teachers' Section formed in 1937 was disbanded early in the year, a few of its members continuing.

We would record with deep regret the deaths of Mr. H. Stuart Thompson on 3 March, 1940, and of Mr. Charles Bartlett on 30 November, 1940. Both were members of long standing, and eminent in botanical and entomological circles respectively. Mr. Thompson was a man who possessed detailed knowledge of his subject and was a true naturalist in every sense of the term, whilst Mr. Bartlett, in addition to his great desire to retain the existence of the Entomological Section, acted as joint-auditor of the Society's accounts for many years.

Owing to the black-out conditions, meetings of the Society have been held on Saturday afternoons, the attendance throughout having been limited. The Annual Field Meeting organised by the Field Section was held on 15th June at Oldbury Court, Frenchay and Stapleton under the leadership of Mr. Ivor Evans.

During the year there have been 12 resignations and 25 new members elected, making the total membership 219.

For obvious reasons it has been a year of little creative work or of progressive ideas. The whole energy of your Council has therefore been concentrated on the problem of maintaining the membership and the continuity of meetings, thus enabling the Society to resume its full activities in the coming times of peace. With the same object, Council has authorised the continued publication of the *Proceedings*. In thanking members for their loyalty, Council would stress the importance of the continuation of their subscriptions to and interest in their own and kindred societies.

M. DORIS HILEY, *Hon. Secretary.*

The Hon. Treasurer in Account with the Bristol Naturalists' Society

Dr. RECEIPTS AND PAYMENTS FOR THE YEAR ENDING 31st DECEMBER, 1940. Cr.

1940		1940		1940		1940	
£ s. d.		£ s. d.		£ s. d.		£ s. d.	
To Members' Subscriptions:—		By Subscriptions:—		Ray Society		1 1 0	
5 0 0	Life .. ..	.. ..	58 0 0	.. ..	.. ..	.. ..	2 10 0
	Ordinary: 1940 .. ..	.. ..	10 0	.. ..	.. ..	.. ..	1 2 0
	" 1941 .. ..	.. ..		.. ..	.. ..	.. ..	
59 0 0	Associate: 1939 .. ..	.. ..	1 0 0	.. ..	.. ..	.. ..	
18 7 6	" 1940 .. ..	.. ..	11 15 0	.. ..	.. ..	.. ..	
	" 1941 .. ..	.. ..	5 0	.. ..	.. ..	.. ..	
	Junior: 1940 .. ..	.. ..		.. ..	.. ..	.. ..	
			13 0 0	.. ..	.. ..	.. ..	
			17 6	.. ..	.. ..	.. ..	
83 7 6			72 7 6	.. ..	.. ..	.. ..	
5 12 6	Sale of Publications .. ..	.. ..	12 9 7	.. ..	.. ..	.. ..	
1 0	" Biological Teachers' received after .. ..	.. ..	10 0	.. ..	.. ..	.. ..	
25 0 0	" Section disbanded .. ..	.. ..		.. ..	.. ..	.. ..	
	Grants towards <i>Proceedings</i>:— .. ..	.. ..		.. ..	.. ..	.. ..	
	Additional 1938 .. ..	.. ..	11 2 0	.. ..	.. ..	.. ..	
	" 1939 .. ..	.. ..	6 12 0	.. ..	.. ..	.. ..	
1 4 0	Interest on deposit .. ..	.. ..		.. ..	.. ..	.. ..	
			17 14 0	.. ..	.. ..	.. ..	
			1 7	.. ..	.. ..	.. ..	
115 5 0			103 2 8	.. ..	.. ..	.. ..	
28 8 6	Subscriptions to Sections per contra .. ..	.. ..	25 7 0	.. ..	.. ..	.. ..	
74 14 6	Balance from last Account .. ..	.. ..	60 10 3	.. ..	.. ..	.. ..	
							
			£188 19 11	.. ..	.. ..	.. ..	
218 8 0				.. ..	.. ..	.. ..	

Subscriptions to Sections paid over per contra .. 90 8 8
 Balance to next Account:— .. 25 7 0
 Cash at Bank .. 24 19 3
 On Deposit at P.O. .. 45 6 0
 Cash in hands of Hon. Sec. .. 2 19 0
 73 4 3
 £188 19 11

A. H. PEACH, Hon. Treasurer,
 15 January, 1941.
 Audited and found correct.
 ERNEST H. COOK,
 F. W. EVENS, A.C.A. } Auditors.
 Bristol, 15 January, 1941.

LIBRARIAN'S REPORT

FOR THE YEAR 1940

BY great good fortune the Library escaped damage in the fire that destroyed a great part of the Natural History Museum. As the Library occupies such a vulnerable position near the centre of the city, however, it was considered advisable to disperse as many as possible of the more valuable volumes to places of relative safety outside Bristol. A part of the Library has already been removed, and other books will follow as soon as arrangements can be made. An exceptionally generous offer has already been received from one country member, Mr. F. G. Hudson of Dursley, who has placed at the Society's disposal a room that will probably accommodate up to a thousand books. Although it may not be possible to evacuate the whole of the Library in this way, it is hoped that at least several runs of journals not otherwise available in this part of the country, as well as the stocks of past issues of the *Proceedings*, may be saved from destruction.

A beginning was made during the year on the work of catching up with arrears of binding. A grant of £5 was made by Council for this purpose, and the binding of seven journals has now been brought up to date. Owing to the probability of increasing costs during the war and the continuance of high prices after the war, it was decided to spend a further twenty pounds on binding immediately. The Library will greatly benefit from this grant, as it is being used to bind the valuable and probably irreplaceable publications of the Belgian Museum of Natural History, the condition of which was rapidly deteriorating. The Ornithological and Geological Sections have kindly undertaken to bear the cost of binding the journals presented by them to the Library.

Two additions have been made to the Exchange List during the year. From the London Natural History Society the Library will receive the *London Naturalist* and the *London Bird Report*, and from the Freshwater Biological Association the *Annual Report* and *Scientific Publications*.

The Society is indebted to Mr. F. Stenhouse Ross and to Mr. H. Dunncliff for the presentation of books, and to Mr. A. C. K. Fear for the loan (for the duration of the war) of a number of up-to-date text books on Botany and Geology. Journals have been received as before from the Geological, Entomological, Botanical and Ornithological Sections. In addition, the Ornithological Section has presented a set of typescript Reports (numbers 1-10) on Somerset Birds—the fore-runners of the printed Reports already on the Library shelves. The *Zoological Record*, 1938, and Balfour-Browne's *British Water Beetles*, volume 1 (Ray Society Monograph), were received by subscription, and volume IV of Witherby's *Handbook of British Birds* by purchase.

The number of entries in the Borrowing Book for the year 1940 was 115.

H. GORVETT, *Hon. Librarian.*

REPORT OF BOTANICAL SECTION

1940

THE Botanical Section has held a meeting each month throughout the year and the material exhibited has maintained the interest of members.

At the annual meeting Prof. Skene was again elected President and Mrs. E. M. Bell was appointed to succeed Mr. Glasspool as Hon. Secretary. Several meetings of particular interest have taken place, including an instructive visit to the Botanic Garden conducted by Prof. Skene.

Two interesting finds of plants new to the district were reported. Mrs. Sandwith showed specimens of *Salix chrysocoma*, with both male and female flowers in the same catkin, and of *Poterium officinale* and *Vallisneria spiralis*. Mr. Evans showed, among other adventive plants, *Scorzonera hispanica* and *Bunias orientalis*. Dr. Hughes and Miss Wethered reported a new station on Kenn Moor for *Azolla filiculoides*. Mr. How is reviving our interest in fungi. At the annual exhibition Mr. Rowley showed mesophytic and xerophytic species of the same genus in *Euphorbia* and *Asclepias*, and Mr. Evens had a fascinating exhibition of magnified seeds.

The death of that keen botanist, Mr. H. Stuart Thompson, has been much felt. He joined the Section when it was revived 15 years ago and has contributed much by his deep knowledge and enthusiasm.

ETHEL M. E. BELL, *Hon. Secretary.*

REPORT OF ENTOMOLOGICAL SECTION

1940

Jan. 13. 76th Annual Meeting, held at 22 Alma Road, Clifton. The President, Mr. J. W. Norgrove, and the Hon. Secretary, Mr. C. Bartlett, were re-elected. The Hon. Secretary reported that six meetings had been held in 1939, with an average attendance of sectional members of 5.6 out of 14 members, four members had not attended any meeting, and only five members had contributed papers, notes or exhibits. A discussion took place on the advisability of obtaining new members, and the President undertook to interview any persons suggested to him. Mr. Norgrove exhibited two drawers of *Geometrae* containing genera *Ennomos*, *Himera*, *Phigalia*, *Nyssia*, *Biston*, *Amphydasis*, *Hemerophila*, *Cleora* and *Boarmia*.

April 9. Meeting held at 5 Hanbury Road, Clifton. The President explained that it had not been possible to hold meetings in February and March on account of illness of members. The Hon. Secretary called attention to the following notes of local interest: Mr. H. Womersley (an old member of the Section) had published a book on the "Primitive Insects of South Australia," which had been described by the reviewer as a "masterly work" (*E.M.M.*, March, 1940, p. 72), an article had appeared in the *Entomologist* for March, by Baron de Worms, on a new British *Agrotid*, viz. *Procus (Miana) versicolor*, related to *Strigilis*, from the neighbourhood of Gloucester, and the *Bristol Evening Post* of April 4, 1940, had reported that a specimen of *Nymphalis Antiopa* was seen in his garden at Lodway—Easton-in-Gordano—by Mr. W. H. Kettlewell, of which, as spring records of this rare migrant are very few, confirmation would be of interest.

Exhibits: Mr. A. Kromler—a live ♀ specimen of *Agliafau* just emerged from larva taken at Zurich last August; Mr. Peach—Pupæ of *Euchloë cardamines*; Mr. Bartlett—Eight specimens of *Tephrosia consonaria*, including a melanic specimen described in the *Entomologist* for April as a new aberration (ab. *waiensia*), from a limited area in the Forest of Dean in 1938: Mr. Bartlett's specimen, with others, was taken near Tintern, and he considered the markings showed degeneration.

May 4. Excursion to Clevedon. The members took bus from Bristol to Tickenham and proceeded via Cadbury Camp to Clevedon where Mr. Audcent kindly provided tea and exhibited a large number of British and foreign Diptera (of which he possesses nearly 3,000 species) and remarked upon their habits and localities. Having thanked Mr. and Mrs. Audcent for their hospitality the party dispersed about 7 p.m.

Oct. 19. Meeting held in the Library, Bristol Museum. Mr. Peach exhibited series of bred *Pieris brassicæ*, including ♂ with central spot on fore wing, and *Euchloë cardamines*, including a small ♂ with yellowish blotch on apex, and *Polyommatus icarus ab cæca* taken near Blandford. Mr. Bartlett contributed notes from papers by Mr. E. B. Williams, given to the Royal Entomological Society in

1939-40, describing his captures of insects in a light trap, and how the numbers that were attracted were affected by temperature and atmospheric conditions. He also reported that he had called upon Mr. N. H. Kettlewell at Easton-in-Gordano, and confirmed his seeing a specimen of *N. Antiopa* in his garden on March 23, 1940, as reported at our meeting of April 9.

It is with great sorrow that we have to report the death on Nov. 30 last, at Weston-super-Mare, of Mr. Chas. Bartlett. Mr. Bartlett had for many years been President and Secretary of the Entomological Section. His keen interest in the work of the Section and his extensive knowledge of all branches of Entomology are irreplaceable. He was always ready to take infinite trouble to help and advise young members, and was glad to show his fine collection to his friends. All who knew him loved him and will miss him.

J. W. NORGROVE, *President*.

REPORT OF FIELD SECTION

1940

EVEN under war conditions your Section has been able to continue some of its functions although many of its activities were modified to suit altered circumstances.

It was not considered advisable to print a programme for the whole session, but, from time to time, circulars were issued giving particulars of the field meetings for the ensuing few weeks. By this means it was found possible to allow for rapid and successive alterations in arrangements.

Necessity decreed that the meetings should be held near Bristol, thus involving the minimum of transport, and the usual policy of examination and recording of a particular district was therefore waived.

The following four field meetings were carried out:—

- 4 May. Failand and Abbots Leigh. Leader: Mr. Ivor Evans.
- 15 June. Oldbury Court, Frenchay and Stapleton. Leader: Mr. Ivor Evans.
- 17 Aug. Brislington and Hanham. Leader: Mr. F. W. Evens.
- 14 Sept. Flax Bourton and Dundry. Leader: Mr. H. O. Edmonds.

In addition, six field meetings for observation on plant life were held, under the leadership of Mr. Ivor Evans, as follows:—

- 27 April. Right bank of River Avon.
- 18 May. Left bank of River Avon.
- 22 June. Brislington, Hanham and Keynsham.
- 20 July. Shirehampton and Hallen Marsh.
- 24 Aug. Conham and Brislington.
- 21 Sept. Stapleton and Oldbury Court.

Although the attendance at most of these meetings has been relatively small, members are confident that in wartime they serve a useful purpose.

At the Annual Meeting of the Section, owing to the unusual conditions, the Officers and Committee were re-elected *en bloc*. Eleven new members have been elected during the year and the total membership now stands at 75.

M. DORIS HILEY, *Hon. Secretary.*

REPORT OF GEOLOGICAL SECTION

1940

PROFESSOR Whittard, Dr. Wallis and Mrs. Marsden continued to serve as President, Vice-President and Hon. Treasurer respectively. Mr. Stenhouse Ross was re-elected Hon. Secretary, but, finding himself unable to continue, was succeeded in April by Mr. Ashby. The committee consisted of Professors Gordon and Reynolds, Dr. Stanley Smith and Messrs. Barke, Turner and Tutchner. Mr. McMurtrie acted as auditor.

Two short papers were read at the Annual Meeting on January 29: the first, by Miss Mead, entitled "Geology in school," the second, by Dr. Stanley Smith, on "Geological observations in Vallis Vale."

The close relationship between scenery and geology were vividly illustrated by Dr. A. K. Wells in a lecture on "A geological journey through South Africa" given on February 17.

On March 16 Dr. L. R. Moore presented an authoritative account of "The fossil flora and fauna of the Bristol Coalfield."

An evening excursion was made on May 7 to Portishead, where, under Dr. Wallis's leadership, a search for fish remains in the Old Red Sandstone was rewarded by the finding of several *Holoptychius* scales. On June 8 an excursion to Wick under Dr. Stanley Smith's direction included a visit to the works of the Golden Valley Ochre and Oxide Co., where members were kindly conducted through the ochre mine, and were afterwards shown stocks of various imported pigments by Mr. W. G. Wade. The structural and lithological features of the area proved particularly interesting.

Professor Whittard led a party to the proposed site of a water reservoir in the valley of the Little Avon River at Wickwar on July 6. Messrs. Blackburn and Rowntree explained the mechanism of the gauge set up to measure the flow of water down the stream. A feature of particular interest in this area is the existence in the valley floor of small, previously misidentified inliers of an unusual facies of Wenlock Limestone which members examined at a trial pit. The party enjoyed a pleasant surprise when they found a picnic tea kindly prepared by Mrs. Whittard and Mrs. Stanley Smith awaiting them at the end of the afternoon.

The final excursion took place on September 7 when Dr. Wallis conducted a large party to Goblin Combe where exposures of Carboniferous Limestone and interstratified basaltic rocks were visited.

The opening meeting of the Winter session was held on October 19 when a large gathering of members and parties of pupils of local schools found much to delight and instruct in an exhibition of new apparatus, museum exhibits and recently acquired specimens in the Geological Department of the University. Professor Reynolds and Professor Whittard, assisted by willing helpers, kindly provided tea on this occasion.

On November 16 Sir Lewis Leigh Fermor in a lecture entitled "India's Mineral Resources and the War" gave convincing statistical evidence of that country's ability to play a vital part in the Empire's munitions production.

It is gratifying to record, in spite of adverse circumstances, an increased membership of the Section, which now stands at 65.

We regret the death of Mr. H. Stuart Thompson and the resignations of Messrs. R. E. Cleeve, H. J. Lucas and S. W. Mappin.

As new members we welcome Mr. C. W. Blackburn, Mr. J. Clendinning, Dr. J. Menzies Cormack, Mr. D. T. Donovan, Sir Lewis and Lady Leigh Fermor, Professor W. T. Gordon, Mr. A. H. Gunner, Mr. M. M. Phillips, Mr. N. A. F. Rowntree and Dr. A. K. Wells.

D. F. ASHBY, *Hon. Secretary.*

REPORT OF ORNITHOLOGICAL SECTION

1940



IT is gratifying, in the present abnormal times, to record the continued progress of this Section. With newcomers and resignations about equal the membership list now totals 74, and the finances show a credit balance of £3 18s. 9d. at the close of the year's working.

The average attendance at six meetings has been good, although of necessity rather smaller than in recent years. The call of other duties rather than other attractions has undoubtedly prevented some members from attending regularly. To avoid the difficulties of moving in the black-out, dates were arranged to coincide with the full moon, but later, in view of air raid risks, it was decided that lunar assistance must be regarded as a potential danger, and the last three meetings were therefore held on Saturday afternoons.

"Falconry, Ancient and Modern" was the subject at the *January* meeting, when Mr. J. H. Savory, in giving a lantern lecture, described the general management of Hawks, and the sport of Falconry as carried out from early times. In *February* the Rev. C. J. Pring lectured on "Some bird-haunts of the West Scottish Coast," and showed a fine series of slides depicting sea-bird colonies from Handa Island in the north to Ailsa Craig and Wigtown in the south. At the *March* meeting, held jointly with the Botanical Section, the Rev. R. Jeffcoat spoke on "Wild-life in South Africa" and illustrated his account with colour films taken on a recent visit to that area. Some of the floral scenes were especially beautiful.

In *October* Mr. J. H. Savory revived an old favourite when he lectured, with excellent lantern slides, on "Bird-life on Texel." At the first of two meetings in *November* the subject was "New Guinea and its Birds." Miss A. G. Stocqueler, in describing the country and the customs of its natives, showed a number of colour films, and the President, Mr. H. Tetley, in speaking on the bird-life, dealt, in particular, with Birds of Paradise and other highly decorative groups. At the final meeting held on the last day of the month Mr. Tetley gave a most interesting lecture on "The Structure of Birds," and illustrated his talk with skeletons and a reconstruction model of the fossil bird *Archæopteryx*.

Opportunities for observational work have been few, but, as in past years, a census of breeding pairs at the Brockley and Banwell Heronries was undertaken.

The following members are serving with the Forces:—Messrs. W. Ashley, M. Brown, B. King, R. D. Purchon and G. Trennery, to all of whom the Section extends every good wish. It is with relief that news has been received of Dr. Purchon, who was reported missing following the Dunkirk evacuation. He is now known to be safe and a prisoner of war.

For the immediate future it will be realized that it is now quite impossible to invite Ornithologists from a distance to come and talk to the Section, and it is therefore to be hoped that lectures or papers will be forthcoming from among members themselves. The Section is indebted to both the President and Mr. Savory for twice filling the gap in 1940.

H. H. DAVIS, *Hon. Secretary.*

Account of the Annual and General Meetings

1940

THE 77th Annual Meeting of the Society was held in the Botanical Department of the University on 20 January, when the President, Professor Macgregor Skene, was in the Chair. The reports of the Hon. Treasurer, Hon. Librarian and Hon. Secretary were read and adopted. Mr. Stenhouse Ross having intimated his inability to continue as Hon. Secretary, Miss M. D. Hiley was elected, with Miss A. E. Fitzjohn as Assistant Hon. Secretary. The President, in thanking the Hon. Officers for their work, stressed the necessity for the normal activities of the Society to be continued as long as possible. He then gave his Presidential Address, and showed a series of photographs of experiments with bees, illustrating their ability to detect variation in colour.

In view of war conditions it was decided not to hold the Annual Dinner.

The 604th General Meeting was held on Saturday, 2 March, in the Botanical Lecture Theatre of the University with Professor Macgregor Skene in the Chair. Mr. F. G. Hudson gave a talk entitled "Archæology to the Naturalist."

The 605th General Meeting was held on 15 June at Oldbury Court, Frenchay and Stapleton, and was led by Mr. Ivor Evans.

The 606th General Meeting, held on 12 October in the Botanical Department of the University, took the form of an Exhibition meeting; the President was in the Chair. This was followed by an informal reception by Professor and Mrs. Macgregor Skene in the Wiglesworth Library.

The 607th General Meeting was an Open Meeting held in the Botanical Lecture Theatre of the University on 2 November, with the President in the Chair. Professor C. M. Yonge gave an illustrated lecture on "Giant Clams."

The 608th General Meeting was held in the Wiglesworth Library on 7 December, with the President in the Chair. Professor W. T. Gordon of King's College, London, gave a lecture on "The Scientific Basis of the Jeweller's Art."

M. DORIS HILEY, *Hon. Secretary.*

Obituary Notice

HAROLD STUART THOMPSON was born at Bridgwater in 1870. His family belonged to the Society of Friends and he was sent to school at Sidcot and later at Bootham, where he distinguished himself as a cricketer and footballer. He went on to the University College of Bristol and later to Christ's College, Cambridge. As a young man he practised for some time the profession of Land Surveyor and, during the last war, he acted as a timber supply officer. At one time he was a Fellow of the Linnean Society and was given the honour of election as an Associate in 1930.

His main interests were always in natural history and archæology. As a boy he was the first to record the occurrence on Bleadon Hill of the pale yellow rock-rose, a reputed hybrid between *Helianthum Chamæcistus* and *H. polifolium*. His profession allowed him to indulge in those country pursuits near to his heart—walking, fly-fishing and collecting; in later life he devoted himself entirely to them. But though his interests were wide he was first and foremost a botanist. He collected seriously both at home and abroad and amassed large and critical herbaria. His British Herbarium is now at Birmingham University and his European Herbarium in the National Museum of Wales.

He was the author of several books and of many papers and notes. His *Alpine Plants of Europe*, *Sub-alpine Plants of the Swiss Woods and Meadows* and *Flowering Plants of the Riviera* had a wide circulation and are probably the most useful guides in English to the regions with which they deal. Important scientific work was published in papers in the *Journal of Ecology*, Vols. 10 and 18, dealing with the changes in the vegetation of the Somerset coast. He took the chief part in securing the purchase of the Sharpham Moor Plot near Glastonbury, on which is preserved the rare hybrid sedge *Carex riparia* × *lasiocarpa*. This plot is now held by the Society for the Preservation of Nature Reserves.

For many years he had been a devoted member of the Somerset Archæological Society and of the Bristol Naturalists' Society. He was a regular attender at our General Meetings and at those of the Botanical Section and frequently brought matters of interest to our notice. These were usually the result of his own observation. He was a most alert observer of nature, and his mind was always in search of explanations for anything out-of-the-way. He has been missed at our meetings and his death leaves us the poorer by an active mind and a most kindly nature.

M. S.



H. STUART THOMPSON

1896

Photo. : E. B. Mowll]

[To face p. 88

Bristol Botany in 1940

BY CECIL I. SANDWITH

(Read in title, March 1, 1941)

WE are at war, and present conditions have seriously limited our botanical activities. The cold spring, with hail and snow on April 16, did not prove disastrous and, generally speaking, 1940 was a satisfactory season for the agriculturalist.

Considering the difficulties and limitations, the year 1940 has not been entirely unproductive:—

Bunias orientalis Linn., a rare casual in this district, was found on Ursleigh Hill, S., by Mr. Ivor Evans. Old records in the *Bristol Flora* are as far back as 1899 and 1900, from several spots by the G.W. and Midland railways between Bristol and Bath, the only recent record being from Avonmouth Docks, 1932, Gibbons.

Sisymbrium officinale Linn. var. *leiocarpon* DC. By the canal close to Sham Castle Lane, Bath, S., J.P.M. Brenan.

Tilia cordata Mill. Beech wood above Wotton-under-Edge, G., J.P.M. Brenan.

Geranium pusillum Linn. Hanham Ferry, G., Ivor Evans.

Ononis spinosa Linn. A form with small blue flowers, approaching the continental var. *violacea* (Peterm.) Wohlf., which differs in having tiny flowers with a very short standard. One isolated bush on Inglestone Common, G., found by Mrs. B. Welch in August, 1939. The flowers were sent to Kew and compared with the R.H.S. Colour Chart, matching what they call the palest tint of 'Aster Violet.' The bush was healthy and thriving in 1940, but mature pods have not yet been found. Near by there is plenty of typical *O. spinosa* with larger, rosy pink flowers, but this little bush has selected a spot apart, and being unusual, is apparently nameless, which seems a pity. It needs study and observation.

Medicago falcata Linn. Thicket by the Avon, Hanham Ferry, G., C. and N. Y. Sandwith.

- Poterium officinale* A. Gray. Field off the by-road from Grovesend to Itchington, G., a second locality, *Dr. David Prowse*.
- Oenanthe fluviatilis* Coleman. In the Kennet and Avon Canal between Bath and Bathampton, S., August, 1940, *C. and N. Y. Sandwith*. In the *Bristol Flora* there is a record, "In the Canal, Bath," 1850, *Withers*, but in "Bristol Botany in 1914," White deplored the loss of the *Oenanthe*, of which he said, 'there can be little or no hope.' It is encouraging to find the *Oenanthe* in perfect condition still in the Canal near Bath.
- Tragopogon porrifolius* Linn. Still below Cook's Folly, G., near Banks' and Lightfoot's locality of 1773.
- Taraxacum paludosum* Schlecht., *sens. lat.* Plentiful on the moor, Weston-in-Gordano, S., *C. and N. Y. Sandwith*.
- Ulmus Plotii* Druce. Large trees near Henbury, G., *J. P. M. Brenan*.
- Ceratophyllum demersum* Linn. In the Avon between Conham and Hanham Ferries, G., *C. and N. Y. Sandwith*.
- Orchis mascula* Linn. One fine specimen with white flowers in woodland between Tickenham and Wraxall, S., *T. H. Green* and *C. Sandwith*.
- Juncus compressus* Jacq. Inglestone Common, G., *C. and N. Y. Sandwith*.
- Typha angustifolia* Linn. Pool in the dunes near Berrow, S., *N. E. G. Cruttwell* and *J. P. M. Brenan*. Dr. W. Watson of Taunton tells me that there was a vague rumour of this plant having been seen on the dunes some ten years ago, but as neither he nor Mr. Miller could find it during his ecological investigation, he considered that it was too doubtful to mention in his report. This being so, Mr. Brenan's find is a valuable record.
- Sparganium neglectum* Beeby. By the Canal at Bathampton; and by a stream at Bathford, S., *C. and N. Y. Sandwith*.
- Potamogeton nodosus* Poir. In a paper in *Journ. Bot.* lxxvii. 56-62 (1939), Messrs. Dandy and Taylor show that the supposed endemic *P. Drucei* Fryer, which has been the subject of so much discussion and argument, is neither a new British species nor a hybrid, but is nothing more nor less than the distinct and widespread continental *P. nodosus*. The plant was first collected in our area by the *Rev. W. H. Painter* in 1884 in the West Gloucestershire part of the Avon near Brislington, and was first

recorded (as *P. Drucei*) in *Journ. Bot.* lvi. 82 (1918) on the evidence of material gathered at Saltford, N. Somerset, by *Mrs. Wedgwood* and *Mr. C. Bucknall*. This beautiful species is now found abundantly in the Avon from Conham up to Bathford, and last August was discovered by *Mr. A. H. G. Alston* and *C. and N. Y. Sandwith* higher up in both vice-counties of Wiltshire, where it was traced as far upstream as Staverton, occurring in great patches in several spots, as at Limpley Stoke, Avoncliffe and Bradford-on-Avon. It also grows in Dorset and Berkshire.

× *P. decipiens* Nolte. Still in the Avon at Crews Hole and between Conham and Hanham Ferries, G.; and in the Kennet and Avon Canal at Bathampton, S., August, 1940, *A. H. G. Alston*, *C. and N. Y. Sandwith*.

P. Friesii Rupr. In the Kennet and Avon Canal between Bath and Bathampton, S., August, 1940, *C. and N. Y. Sandwith*.

Azolla filiculoides Lam. Found in a rhine, Moor Lane, S. Clevedon, in 1931 by *Miss Roper*; was a first record for Somerset and was published in the notes of the Botanical Section, *Somerset Arch. Soc.*, in 1931: "escaped from a private pond on the Clevedon Court Estate where it had been planted a few years before." The record was not published in the *Proceedings B.N.S.* owing to the fact that the Botany Notes had lapsed. It was thought advisable to add this note as enquiries were made from the North as to whether the Bath locality published last year was a new county record.

Aliens (coll. *C. and N. Y. Sandwith* unless otherwise stated). The following are new to the Bristol list: *Ranunculus arvensis* L. var. *inermis* Koch and var. *tuberculatus* (DC.) Koch, and *Agrostis pisidica* Boiss. (new to Britain), on the N. Somerset side of the city; *Silene Behen* L. on waste ground, St. Werburgh's, G., 1927; *Polygonum sachalinense* Schmidt at St. Philip's Marsh, G.; *Avena sterilis* L. (with *J. P. M. Brenan*) and *Lepturus cylindricus* Trin. at Wapping Wharf, Bristol Harbour, G.; and *Scorzonera hispanica* L. (new to Britain) on waste ground by Portway, G., *Ivor Evans*. The root of the last is eaten as a vegetable, like Salsify.

Other aliens of rare occurrence noticed in 1940 were: *Euclidium syriacum* (L.) R. Br., *Bunias Erucago* L. (hitherto only once recorded, from Portishead Dock), *Althaea hirsuta* L. (coll. *Ivor Evans*), *Lathyrus*

inconspicuus L., *Bifora radians* M. Bieb. and *B. testiculata* (L.) DC., and *Campanula Rapunculoides* L., all on a tip on the N. Somerset side of the city; *Lathyrus hirsutus* L. on Wapping Wharf, G.; and *Mercurialis annua* L. "var." *ambigua* (L.) by Portway, G. *Cichorium Intybus* L. var. *glabratum* (Presl.) Gren. et Godr. also occurred on the N. Somerset side of Bristol last year; this variety was omitted from the *Adventive Flora* but had been recorded, in *B.E.C.* 1918 Rep. p 385 (1919), from St. Philips, G., by *Miss Todd*.

The sudden death of Harold Stuart Thompson after an attack of influenza was a shock to friends who had known him for a quarter of a century. His familiar figure will be missed at the meetings of the Bristol Naturalists' Society. On these occasions his enquiring mind was ever ready to raise questions which might lead to an interesting discussion on the topic of the evening. He had the gift of being able to interest himself in the work of others, and was desirous that it should be recognised and appreciated. This sense of justice was probably due to his Quaker upbringing. One could not fail to recognise a generous nature. His peculiarly sensitive temperament has been saved from all the anxiety and disruption which marked the closing months of the year. Mr. Thompson will long be remembered for his books, *Alpine Plants of Europe* (1911) and *Flowering Plants of the Riviera* (1914), which supplied a real want for English amateur collectors on the continent. He added the interesting hybrid, *Carex evoluta*, which he found on our peat moors, to the British flora, and was the first to detect *Agrimonia odorata* within the area of the Bristol district, while his papers on the vegetation of the Berrow flats were the work of a keen observer who was also an enthusiastic amateur ecologist.

Ornithological Notes, Bristol District, 1940

By H. H. DAVIS, M.B.O.U.

(*Read in title, March, 1 1941*)

I. THE SEVERE WINTER OF 1939-40 AND ITS EFFECT ON BIRD-LIFE

BEFORE placing on record such observations as have been possible, it may be of interest to make some reference to the unusually severe weather which, setting in toward the close of the previous year, continued throughout the first six weeks of 1940. In common with most areas, January here proved to be colder than any month of the present century. Conditions were extremely hard from the 15th onwards, and by the night of the 21st-22nd the thermometer had fallen to 4° F., i.e. 28 degrees of frost, at the Long Ashton Research Station where, on the same night, 31 degrees of ground frost was registered. For at least a week following the 18th, the North Somerset reservoirs were completely frozen over, and here also on the 21st-22nd the thermometer registered 21, 26 and 24 degrees of frost at Barrow Gurney, Blagdon and Cheddar respectively. On the 28th, freezing rain, better described as an ice-storm, made conditions even worse and road transport almost impossible. Everything became thickly coated with ice, the sheer weight of which caused widespread destruction to trees and, in exposed places, telegraph poles and wires were brought down on a scale without precedent for the district. A temporary thaw at the end of January was followed by more frost in the first half of February but there was no repetition of the previous abnormally low temperatures.

The general effect on bird-life over the British Isles as a whole has been recorded as being far more serious during the 1939-40 winter than in the locally severe weather of 1928-29, but not so disastrous as during the widespread and prolonged cold of 1916-17 (cf. *British Birds*, Vol. XXXIV, p. 118). Reports of birds found dead in the Bristol area in 1940 were surprisingly few and, though comparative data are lacking, it seems probable that the mortality rate was lower than in either 1917 or 1929. This may have been due to a southerly retreat of some species, as is suggested by the sudden diminution at Long Ashton in the numbers of Greenfinches, Linnets, Chaffinches

and Skylarks, while an observer on a train journey between Worcester and Mangotsfield noted a southward movement of Skylarks, Fieldfares and Redwings over the whole way. Despite this, however, the intense cold was not without its effects, and in North Somerset dead Starlings and Blackbirds were found at Long Ashton, and many Coot perished at Blagdon. On the Gloucestershire side of the City the few remaining Redwings were obviously hard driven, and Skylarks were to be seen feeding in gardens and farmyards.

With the advent of spring it became apparent that destruction, particularly among smaller passerines, had been considerable, and in most localities breeding pairs were below normal numbers. At Dyrham, Long-tailed Tits, Goldcrests and Kingfishers were missed from their usual haunts, and in parts of North Somerset the Stonechat, always a victim of severe weather, was noticeably scarce. Woodpeckers also suffered, and at Stoke Gifford the Green and Lesser Spotted were almost entirely absent during the nesting season. The autumn months brought further evidence of reduced numbers, Chaffinches and Yellow-Buntings, among others, were generally fewer than usual and parties of Titmice below average size. Finally, the Stonechat failed to put in an appearance at Stoke Gifford where, normally, it is a regular autumn visitor to root fields and railway embankments.

The most striking features during the cold spell were the abundance and wide distribution of grey geese and the unusual sight of Tufted Duck in the Cumberland Basin docks. Geese, in varying numbers up to fifty or more, were observed at Acton Turville, Tormarton and other parts of the Cotswolds, at two or three points south of the Mendips and in various places along the Severn estuary. Several observers noted geese flying over the City, and a quite exceptional record was established when about thirty were seen to alight in a field between Southmead and Horfield Common—well within the City boundary.

II. SOME NOTEWORTHY OBSERVATIONS

Owing to war-time restrictions, bird-watching activities in 1940 have been on a very limited scale. With the exception of Blagdon, where occasional visits have been permitted, the North Somerset reservoirs remained closed throughout the year, and thus records of interesting passage birds and water-fowl have undoubtedly been lost.

Further, it has been quite impossible to pay regular visits to the Severn bank and other good bird haunts. Nevertheless, apart from the wild geese referred to above, a few noteworthy observations have been made, some of which may be singled out for special mention.

A Water-Pipit at Hotwells in December, and the autumn occurrence of a Willow-Tit at Stoke Gifford are events of particular interest. In view of the supposed scarcity of the latter species in the Bristol area it is to be hoped that future observations will establish breeding records for the district. Hobbies were seen at Blagdon in May and a party of four Buzzards near Cleeve in September. Early in January several Bitterns visited Cheddar Moor and, as in the previous year, Smew (including two adult males) arrived at Blagdon. Here also a Gadwall was identified in April and a Little Gull in September. Other important records include a Little Stint near Clevedon in September, and the occurrence in February of an Iceland Gull inland at Stoke Gifford, while the Glaucous Gull noted at Cumberland Basin in the last week of 1939 remained there during the early part of January.

That quite a variety of interesting birds may be found even where activities of the modern builder run riot is well illustrated by notes from an observer on the recently developed Northumberland House Estate, Westbury Park. Here, on an area of some forty acres, now waste ground and allotments and entirely surrounded by houses, such species as Cirl Bunting, Stonechat, Great Spotted Woodpecker and Kestrel have lately been met with, and even so shy a bird as the Jay puts in an occasional appearance. Here also migrants tenaciously cling to their former flight lines, and among those seen in 1940 were Blackcap, Wheatear and Redstart.

The following specific notes are, for the most part, the result of observations by members of the B.N.S. Ornithological Section.

RAVEN (*Corvus c. corax*). In contrast to the previous four years, the Avon Gorge eyrie was on the Somerset side. Young were again successfully reared. A pair was seen over Cleeve Hill on August 22 and September 21.

CIRL BUNTING (*Emberiza c. cirlus*). Of five at Severn Beach on December 22, two, male and female, were among *Spartina* grass on the shore-line and three, apparently birds of the year, about the pleasure grounds.

WATER-PIPIT (*Anthus s. spinoletta*). A pipit, watched at close

quarters along the river-side at Hotwells on December 25 and 26, was undoubtedly referable to this species. In size and call-note it resembled the Rock-Pipit but lacked the olivaceous tints and the generally dingy appearance of that bird. Apart from the streaking, the breast was a clean greyish-white, the outer tail feathers conspicuously white and the legs dark. This is only the second record for the district and the first for the county of Gloucestershire.

WHITE WAGTAIL (*Motacilla a. alba*). One was present at Blagdon reservoir as early as March 2. A single bird was seen on April 21 at Little Stoke where the species has been fairly frequently noticed on spring passage.

WILLOW-TIT. (*Parus atricapillus kleinschmidti*). One was clearly identified along a water-course at Stoke Gifford on September 24. It was seen near the same spot on the 25th and subsequently on various dates until October 23. Close views were obtained and, as compared with the Marsh-Tit, the following details were noted:—sooty-brown crown with little or no evidence of gloss; well marked light patch on secondaries; greater extent of white on cheeks and the generally less smart appearance. The plaintive and drawn out call—often described as the “tchay tchay” note—was always the same, and at no time was there any suggestion of Marsh-Tit calls. A Willow-Tit, possibly the same bird, was seen and heard on the outskirts of Savage’s Wood, Stoke Gifford on December 11. There is only one previous record for the Gloucestershire side of the City (cf. *British Birds*, Vol. XXX, p. 361).

RED-BACKED SHRIKE (*Lanius c. collurio*). A pair nested and reared young on a small piece of waste ground immediately adjoining Yate railway station and only a few yards from the local cinema.

SAND-MARTIN (*Riparia r. riparia*). On May 12, a small colony, perhaps half a dozen pairs, was located nesting in drain pipes in the concrete embankment of a railway cutting near the junction of Winterstoke and Bedminster Down Roads. Drain pipe nesting is also reported from Stapleton where, for several years, a few pairs have bred in a wall between Brinkworthy Road and Stoke Park. (For previous records of colonies nesting in drain pipes in the Bristol area cf. *British Birds*, Vol. XXI, p. 167).

PEREGRINE FALCON (*Falco p. peregrinus*). Two were seen flying upstream between Avonmouth and Severn Beach on February 11, and one was disturbed from Aust Cliff on March 22. Noted also

on two occasions inland—one over Chipping Sodbury Common on April 6 and one at Little Stoke on September 23.

HOBBY (*Falco s. subbuteo*). A pair was viewed at close quarters at Blagdon reservoir on May 12. This is the third successive year that Hobbies have been seen at Blagdon and it seems highly probable that a pair nests in the locality.

COMMON BUZZARD (*Buteo b. buteo*). On September 9 four were watched circling overhead between Cleeve Hill and Brockley Combe. This may have been a family party and suggests a pair having bred in the neighbourhood.

COMMON HERON (*Ardea c. cinerea*). A count of occupied nests at the Brockley Combe Heronry on April 27 totalled twenty-six, a similar number to that of 1939. There were thirty-five occupied nests at Banwell on May 5, the largest count since this Heronry was first recorded.

BITTERN (*Botaurus s. stellaris*). Several were reported from the Cheddar Moor area early in January and a male obtained on the 3rd was sent to the Bristol Museum.

WHITE-FRONTED GOOSE (*Anser a. albifrons*). Although identification was not always possible it seems evident that this was the predominant species among the many grey geese which visited the district during the severe weather of January and February. On the Gloucestershire side White-fronts were noted on various occasions along the river-bank between Avonmouth and Severn Beach and two were shot on January 30. The largest numbers counted were twenty-one and twenty-five on January 1 and 26, and twenty or more, on February 2 and 4. Some, and perhaps all, of a flight of seventy geese over Severn Beach on February 11 were White-fronts. In Somerset forty were seen passing over Cheddar on February 1 and one was obtained near Wick-St. Lawrence on the 3rd.

PINK-FOOTED GOOSE (*Anser f. brachyrhynchus*). No less than five were shot by a local wildfowler on January 30—two from a small party on the Severn bank near Avonmouth and three from a flock of about thirty grey geese in a field adjoining Horfield Common. Of these, two are now in the Bristol Museum Collection. Six or seven were identified, in company with White-fronts, along the river bank between Avonmouth and Severn Beach on February 1 and 2. Although the Pink-foot is a regular visitor to the goose grounds above Berkeley from mid-September to December, it becomes scarce, or entirely

absent, at other times in the Severn area. The above occurrences are therefore of special interest and can only be attributed to the intensely cold weather.

GADWALL (*Anas strepera*). One, evidently a female, was disturbed while feeding among short reeds at Blagdon reservoir on April 14 and, on taking flight, was at once recognised by the conspicuous white speculum. Good telescopic views were afterwards obtained of the bird on the water and all details noted. There is only one previous record for Blagdon.

COMMON POCHARD (*Aythya ferina*). An adult male was frequenting the docks at Cumberland Basin on January 30. As with the following species, this bird had no doubt been frozen out from the North Somerset reservoirs.

TUFTED DUCK (*Aythya fuligula*). During the intense frost of the latter half of January, Tufted Duck were noticed on several occasions about the docks at Cumberland Basin. Ten were counted on the 30th and the local Press reported a number there a few days earlier. Three were seen on the Avon, above Pill, on February 4.

SCAUP (*Aythya m. marila*). A female, evidently another weather driven bird, was seen on the Avon above Sea Mills on January 30.

COMMON SCOTER (*Melanitta n. nigra*). One, an adult male, was present at Blagdon reservoir on April 14.

RED-BREASTED MERGANSER (*Mergus serrator*). Two, "brownheads," were identified at Blagdon on March 31.

SMEW (*Mergus albellus*). Twice met with at Blagdon—three, including two adult males, on January 2, and five, "redheads," on February 25. As adult males, hitherto rarely recorded, have been observed in two successive winters, it may reasonably be hoped that they will now become more regular visitors.

BLACK-NECKED GREBE (*Podiceps n. nigricollis*). One, in almost full winter plumage, at Blagdon reservoir on September 15.

WHIMBREL (*Numenius ph. phaeopus*). A party of thirteen was frequenting the mud-flats below Severn Beach on May 13.

JACK SNIFE (*Lymnocyptes minimus*). Twice seen at Stoke Gifford—one on October 5 and one on November 11.

KNOT (*Calidris c. canutus*). One was seen off Severn Beach on January 1, and three near Clevedon on September 9.

LITTLE STINT (*Calidris minuta*). A single bird was identified near Clevedon on September 9.

PURPLE SANDPIPER (*Calidris m. maritima*). Seen, up to half a dozen or more, on shingle and mud-flats off Severn Beach on various dates in January and February. Seven were counted in the same place on December 22.

GOLDEN PLOVER (*Pluvialis apricaria*). Twice noted at Little Stoke—eleven on January 3 and thirteen on February 7.

GREY PLOVER (*Squatarola squatarola*). Three were seen along the Woodspring Bay mud-flats on February 4.

BLACK TERN (*Chlidonias n. niger*). Single, immature, birds were present at Blagdon reservoir on September 15 and 18.

LITTLE GULL (*Larus minutus*). One, a bird in immature plumage, was clearly identified at Blagdon on September 11. Although previously considered a very scarce visitor, the Little Gull has now been reported from the North Somerset reservoirs on two occasions in autumn and once (in some numbers) in spring within the last three years.

GLAUCOUS GULL (*Larus hyperboreus*). One in buffish-white plumage seen about the docks at Cumberland Basin on various dates from January 1 to 11 was undoubtedly the same bird as that observed there late in the previous December (cf. *Proc., B.N.S.*, 1939, p. 33).

ICELAND GULL (*Larus leucopterus*). An immature bird was identified at Stoke Gifford on February 23. When first seen it was soaring directly overhead in company with a number of young Herring-Gulls with which it corresponded in size but differed noticeably in the entirely transparent appearance of the primary feathers. Later, as the bird heeled over, identification was further confirmed by the creamy-white upper parts and the absence of any black on the wing-tips. This is the first inland record for the Gloucestershire side of the City.

LAND-RAIL (*Crex crex*). One was caught in wire netting at the Long Ashton Research Station on April 22.

COOT (*Fulica a. atra*). Eighteen, probably weather driven birds, were seen on the Avon between Pill and Avonmouth on February 26.

The writer is indebted to Mr. H. Tetley, B.Sc., of the Bristol Museum, who was responsible for collecting most of the data on the severe weather and its effect on bird-life in various parts of the district.

Land Mammals of the Bristol District

By H. TETLEY, B.Sc., F.Z.S.

(*Read in title, March 1, 1941*)

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I. PREFACE

THE last published list of Bristol Mammals is that of C. K. Rudge and H. J. Charbonnier in 1909. Since then more information has become available in various ways, the status of some mammals, such as the Badger, has altered considerably, and a new introduction to the area has appeared in the Grey Squirrel, so that a revision of the list seemed due.

Recent additions to the collections of mammal skins in the Bristol Museum and Art Gallery have also been drawn on for a great deal of information, as will be obvious in many places.

The list does not set out to give the habits of each of the mammals described, but rather the means of identification and the distribution, as far as known to me, together with measurements where necessary. Emphasis has also been laid on certain points such as variation in colour of the Common Shrew, colouration of Stoats in winter, and an apparently local variation in the colour of the Field Mouse. Facts such as these are brought forward as suggestions for future research on animals that are common and easily obtained.

There is still much information wanted on distribution, particularly on such mammals as Bats, and it must not be supposed that the details given are in any way final.

Special acknowledgment must be made to Dr. L. Harrison Matthews, who first started the author on his work on Bristol Mammals and who has helped in many ways, and I also wish to express my obligations to the following for help with information or specimens or in other

ways:—H. L. Audcent, H. C. Baker, H. E. Balch, M. Blackmore, Rev. F. L. Blathwayt, Rev. G. H. Carpenter, H. Cox, Mrs. L. E. Currey, H. H. Davis, Roger Ford, the late Dr. E. T. Glenny, Stanley Lewis, Dr. R. H. Parry, R. I. Pocock, C. Ryman, E. H. Scorrer, J. G. Smith, F. H. L. Whish, Dr. E. Barton White and the late Engineer Captain H. H. Wilmore, R.N.

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II. GENERAL SURVEY

AREA. The boundary of the area taken as the Bristol district runs from Berkeley to Badminton thence through Bath and Wells to Highbridge and up the coast to a point level with Berkeley again. The district includes Steep Holm, an island five miles off Weston-super-Mare.

The Gloucestershire part consists of a wide area of low-lying country bordered on the east by the most southern portion of the Cotswolds.

The Somerset side is more undulating and more wooded. On the southern side of the Mendips, and bordering the Bristol Channel, is a large area of low country, but it is split up by several areas of higher ground. A high ridge runs from Portishead to Clevedon and another much larger from Clevedon to Failand through Cadbury Camp. Just to the north of Weston-super-Mare is Worlebury Hill, while south of it is the promontory of Brean Down (321 ft.), east of which are Bleadon Hill (549 ft.), Crook Peak (628 ft.) and Wavering Down (690 ft.) which borders on Shute Shelve Hill (763 ft.). An isolated hill, Brent Knoll (457 ft.), rises from the low land north-east of Burnham-on-Sea. Between Wells and Axbridge the Mendips rise abruptly to a height of over 800 ft., the highest point on Black Down to the west being 1,068 ft. This is also the highest portion of the area covered by the survey. The northern slopes of the Mendips descend to Blagdon and the valleys of the Yeo and Chew, west of which is the higher ground of Broadfield Down, with Dundry Hill (765 ft.) as the peak and bordering the eastern edge of the low ground. Farther east is undulating country rising up to 600 ft. or so.

The Mendips and outlying hills and Broadfield Down are Carboniferous Limestone, the Cotswolds and Bath district are Oolite. From Nailsea through Bristol to Iron Acton is an area of Coal Measures, while all the country spoken of as low-lying and bordering the Severn

and Bristol Channel and the southern edge of the Mendips is alluvial, and over a great extent of country is no more than 25 feet above sea-level even as far as eleven miles inland. It is in this alluvial district that there is the only area of sandhills, between Brean Down and Burnham-on-Sea.

MAMMALS. The mammals found in this area comprise 9 (or 10) Bats, 5 Insectivores, 6 (doubtfully 7) Carnivores, and 15 (possible 16) Rodents, making a total of about 37. Red Deer and Fallow Deer occur in various parks under artificial conditions.

To examine closely into the distribution of the smaller mammals is not an easy task. Bats are referred to later, but with the others (Shrews, Mice and Voles) trapping has been resorted to and this has been carried out over a wide portion of the area, certain spots being selected. An average of forty to fifty "nipper" traps have been put down, and the resulting "bag" gives an indication of the mammals found there.

The Common Shrew is easily the most frequently caught, and next to it is the Field Mouse, and wherever trapping has taken place, Bank Voles have been caught, thus correcting the "hardly uncommon but local" description in the last list of 1909. The Pigmy and Water Shrews are more local, or less easily caught, and the same applies to the Field Vole, though in this case the latter alternative is more probably correct. The examination of pellets of the Barn Owl, quoted later, gives a different indication of the numbers of the Field Vole when compared with the result of trapping in the same district. This indirect evidence has also been made use of, and a further example is also afforded, in the case of the Dormouse, by the nutshells from nuts eaten by this animal. These can be definitely identified as described later.

NATURAL CONTROL OF MAMMALS. As regards natural enemies, there are, of course, no figures available of the great work Stoats and Weasels undoubtedly do in keeping down the numbers of small mammals. The Fox and Badger are also of considerable use in destroying Rabbits. It is well-known that Owls are of the greatest service in checking Rodents and other small mammals, and some figures of remains found in the pellets of Barn Owls (*Tyto a. alba*) are given. It may be explained that Owls and some other birds cast up the indigestible portions of their prey—fur, bones, etc.—in the form of pellets.

Two sets of pellets were examined—one in March and the other in November—with the following results:—

<i>March.</i>	Mammal skulls, 53.
	Bird skulls, 2. (House Sparrow.)
<i>November.</i>	Mammal skulls, 53.

Both these sets were from Little Stoke, 5 miles north of Bristol, and the material was collected by Mr. H. H. Davis. They may be compared in the following way:—

				<i>March.</i>	<i>November.</i>
Common Shrew	..	..	..	7	8
Pigmy Shrew	..	..	..	1	—
Bank Vole	..	..	..	7	2
Field Vole	..	..	..	35	28
Field Mouse	..	..	..	3	3
Brown Rat	..	..	..	—	4

In the March List all skulls were fully identified, whereas in those in November eight Vole skulls have been omitted, as it was not certain to which species they should be referred.

As is well-known, the Heron (*Ardea c. cinerea*) preys largely on Water Voles as well as on various kinds of fish, etc. These birds also eject pellets, and a series of 26 from a local heronry, Brockley Combe, was examined with the result that in 22, or 85% of the total, the fur, and in some cases the bones, of the Water Vole were discovered.

Some mammals, particularly Rodents, fluctuate in numbers very noticeably and regularly, the causes of which are not fully known. The following quotation, from Knapp's *Journal of a Naturalist*, 4th edition, 1838, p. 137, shows that in the Thornbury district, where this excellent book was written, these plagues were already well-known:—

“In the years 1819 and 1820, all the country about us was overrun with mice; they harboured under the hassocks of our coarse grass (*aira cæspitosa*), perforated the banks of the ditches, occasioned much damage by burrowing into our potato heaps, and coursed in our gardens from bed to bed even during daylight. The species were the short-tailed meadow-mouse, and the long-tailed garden mouse, and both kinds united in the spring to destroy our early-sown pease and beans. In the ensuing summer, however, they became so greatly reduced, that few were to be seen, and we have not had anything like such an increase since that period. It is probable that some disease afflicted them, and that they perished in their holes, for we never found their bodies, and any emigration of such large companies would certainly have been observed yet the appearance and disappearance of creatures

of this kind lead us to conclude that they do occasionally change their habitations."

STEEP HOLM. Steep Holm is geologically a continuation of Brean Down, and lies in the Bristol Channel five miles out from Weston-super-Mare. Its highest point is 256 feet above sea-level.

In order to find out what small mammals there might be on it, two nights were spent there in June, 1935, and three dozen traps were set each night. Conditions were ideal but, in spite of this, no mammals were caught and, in the great majority of cases, the bait had not been touched. It looks, therefore, as if there were no mammals, with the exception of Rabbits and a few Bats; the former have certainly been introduced, and the latter can reach the island by flight. Assuming this to be correct, the result is of some interest. The island apparently was cut off from the mainland in Pleistocene times, i.e. at a later period than that at which Shrews, Mice and Voles appeared, as fossil remains of these animals have been discovered in the Pliocene. These small mammals may have inhabited Steep Holm but have died out later, though, as no remains have been found, this is only supposition. The island certainly is rather bleak and with the exception of the cliff above the landing-beach there is practically no undergrowth, and the soil is very shallow. But it seems rather remarkable that an island close to the mainland is not populated by some small mammals while an isolated one such as St. Kilda, standing out in the Atlantic forty miles west of the Outer Hebrides, possesses a House Mouse (*Mus muralis*) and a Field Mouse (*Apodemus hirtensis*) so distinct as to form a species separate from those on the mainland.

MEASUREMENTS. These give the approximate size of the animal and, except where otherwise stated, have all been taken from the fresh animal. The following abbreviations have been used:—

HB = head plus body, i.e., from tip of snout to root of tail.

Tail = from root to tip, excluding the terminal hairs.

Ear = from base to tip.

HF = hind-foot from heel to tip, excluding the claws.

Dimensions are given in millimetres, 25 millimetres equalling one inch.

COLLECTIONS. These refer to those of the Bristol Museum and Art Gallery, unless otherwise mentioned. But it is much to be regretted that, since this account was written, the whole of the British mammal skin collections, with the exception of Foxes and Badgers, were destroyed in a disastrous air-raid on the night of 24 November, 1940.

III. CHIROPTERA

The difficulty of making a satisfactory survey of the Bats of a district becomes all too apparent when one undertakes such a piece of work. They may be sought for in church towers, roofs of buildings, caves or hollow trees, and, in a large number of cases, will not be found. The crevices they can get into are so small that it is difficult to search every one and in this case particularly a blank may not prove anything. Bats hibernate largely and when a colony of them is examined, e.g. in a cave, it is easy to remove any found suspended from the roof or sides and to replace them after examination.

There are on the British list 12 species and, as there are records of 9 for the Bristol district, and remains of a tenth have been found in a cave, it will be seen that there are many to choose from. In addition, it is highly probable that an eleventh (i.e., Daubenton's Bat) occurs in the district, but so far we have been unable to obtain a specimen.

The present list with details of distribution does go a stage further than the last one published in 1909, but there is still a great deal of information wanted. As the different species are not easy to determine, there is given a comparison of sizes, and separate notes are added in the case of each species. These, of identification and habits, are largely based on or extracted from Barrett-Hamilton's *History of British Mammals*, Vol. I, 1910.

The following table, giving the greatest expanse of wings, may help in identifying any Bat that is caught:—

1.	More than 311 mm.			
	353-387 mm.	..	..	Noctule.
	348-374	„	..	Serotine.
	312-370	„	..	Greater Horseshoe Bat.
2.	290-310 mm.			
	295, 304 mm.	..	..	Leisler's Bat.
3.	225-285 mm.			
	257-285 mm.	..	..	Natterer's Bat.
	254-268	„	..	Barbastelle.
	248-252	„	..	Bechstein's Bat.
	246-260	„	..	Long-eared Bat.
	225-250	„	..	Lesser Horseshoe Bat.
4.	200-225 mm.			
	210-228 mm.	..	..	Whiskered Bat.
	203-218	„	..	Pipistrelle.
	201-227	„	..	Daubenton's Bat.

NYCTALUS NOCTULA (Schr.) Noctule

The Noctule is, with the Greater Horseshoe Bat, the largest Bat on the British list. It has a wing expanse of about 14 inches (355 mm.).

The colour is yellowish or golden brown above and below, and the ear has a rounded tragus. Its flight is high, straight and rapid. Its daytime retreats are usually the hollows of old trees, where it may be found in large companies.

It has been said by previous writers that it is "common and generally distributed," "common in old trees in suitable localities," "generally distributed and sometimes abundant," "apparently local, but widely distributed." The first of these estimates is probably correct at the present day. "Large" Bats are reported from many different parts, but as the Greater Horseshoe occurs, and commonly in places, it is not easy to assign a name without seeing or handling specimens.

In Somerset, Mr. Michael Blackmore found them fairly numerous at Stratton-on-the-Fosse in 1929. At Lympsham one was taken in January, 1929, and a second one (in the church tower) in October, 1933; others have occurred in later years. One from Congresbury is in the Bristol Museum collections and was sent in about June, 1911. Three were smoked out of a hole on the cliffs near Wookey Hole, August 26, 1905 (S. Lewis, *Zoologist*, 1906, p. 69).

On the Gloucestershire side of Bristol, twenty large Bats with long narrow wings were seen by Mr. H. H. Davis flying round an oak tree by Patchway railway bridge on July 1, 1933; these were no doubt Noctules in pursuit of Cockchafer, one of their favourite sources of food. The author saw a number flying high over the Gully on Durdham Down on the evening of September 10, 1936. Their large size and swift flight, with occasional steep dives, were sufficient to identify them.

The following measurements are taken from Barrett-Hamilton, Vol. I, p. 63:—

Males.	HB 76-80	Ear 16-18	Forearm 49-51	Expanse 353-375 mm.
Females.	„ 73-82	„ 16-18	„ 50-54	„ 362-387 „

NYCTALUS LEISLERI (Kuhl.) Leisler's Bat

This Bat is like a much smaller edition of the Noctule. It has an expanse of wing of about 12 inches instead of 14, its flight is said, by Mr. T. A. Coward, to be slower and more erratic than that of the Noctule but it is not easy to distinguish. "In the hand, the smaller size, darker colour, absence of the peculiar smell, and especially the markedly smaller feet, cannot fail to form an infallible criterion as between even the very youngest Noctules and the present species." (Barr.-Ham., Vol. I, p. 100.)

It may be one of the rarest, but on the other hand it is thought that its rarity may be more apparent than real and may be due to the nature of its daytime retreats, which are usually in hollow trees, frequently at some height from the ground and thus inaccessible.

The only record for this district is of one taken in a cottage at Winscombe, Somerset, on October 13, 1915, and recorded by the late Dr. J. Wigglesworth in the *Zoologist*, 1915, p. 432.

The following dimensions are taken from Barrett-Hamilton, Vol. I, p. 87 :—

HB 56-62 Ear 14-17 Forearm 40-44.5 Expanse 295 mm.

PIPISTRELLUS PIPISTRELLUS (Schr.) Pipistrelle

The Pipistrelle is the smallest British Bat, though almost equalled in this respect by the Whiskered. It is brown, slightly lighter on the ventral surface, and can be distinguished in the hand by the presence of a post-calcarial lobe in the wing, and of a rounded tragus as distinct from the attenuated tragus of the Whiskered Bat.

It does not seem possible to distinguish the two species in flight. Barrett-Hamilton (Vol. I, p. 111) says, "... it is believed generally that, while the Whiskered Bat often feeds among trees, snatching its prey while at rest on the leaves and branches, the Pipistrelle usually feeds near them, and takes its food preferably on the wing."

The Whiskered Bat possibly is more frequently seen flying during the day, but both are active for prolonged periods.

The present species is a very common Bat in this district, but perhaps may be outnumbered locally by the Whiskered. It is, however, evident that a good deal more information is required before this can be determined for certain.

For some time past (*Brit. Ass. Handbook to Bristol Neighbourhood*, 1898, p. 203) it has been suggested that it is common in the Gloucestershire part of the district but rare on the Somerset side of the Avon, being replaced by the Whiskered Bat. It seems likely that this is too sweeping a statement and should be modified so that it only applies locally. There is, for example, the following information for Somerset.

Mr. F. H. L. Wish finds that at Lympsham the Pipistrelle is the common Bat. During the summer of 1932 more than 250 Bats were taken from the roof of an inn on the Somerset levels and, though it is not certain that all these were Pipistrelles, this may very well have been the case, as two subsequently caught in the same building proved to be

of this species. Mr. Michael Blackmore informs me that a large colony were dislodged at Stratton-on-the-Fosse gasworks in 1927, but that there were very few there in 1929-1931.

On the Gloucestershire side about a dozen were found, in July, in a church tower a few miles north of Bristol, in company with about 70 Lesser Horseshoes. They did not fly about, as the latter did when disturbed, but scuttled very rapidly along the beams and particularly on the top of them until they got right out of the light, all the time keeping up a great deal of squeaking, not particularly high-pitched.

The following dimensions are taken from Barrett-Hamilton, Vol. I, p. 109 :—

Males.	HB 39-44.5	Ear 10	Forearm 27.5-30	Expanse 206-212 mm.
Females.	„ 34.5-52	„ 10	„ 29-31	„ 203-218 „

[EPTESICUS SEROTINUS (Schr.) Serotine]

The Serotine is almost, if not quite, as large as the Noctule, from which it may be distinguished, in the hand, by the lighter underside as well as by the broader wing, longer ear and lanceolate tragus. It flies lower than the Noctule and is usually more of a glade-haunting species.

It is entirely confined in this country to the South of England and is rarely, if ever, found north of the Thames. But, in addition to the south-eastern counties, Hampshire and the Isle of Wight, it has also been found in north Devonshire by Mr. M. Blackmore, so that with a wide distribution of this kind it is possible it may have been overlooked.

The following dimensions are taken from Barrett-Hamilton, Vol. I, p. 134 :—

Males.	HB 68-79	Ear 19-20	Forearm 49-53	Expanse 348-355 mm.
Females.	„ 72-80	„ 15-23	„ 51-54	„ 354-374 „

[MYOTIS DAUBENTONI (Kuhl.) Daubenton's Bat]

Daubenton's or the Water Bat is slightly larger than the Pipistrelle. It has pointed ears, a lanceolate tragus, slightly-developed post-calcarial lobe, light underside, large foot and a grizzled brown upper surface.

Its name of "Water Bat" is derived from its habits, which are described by Barrett-Hamilton (Vol. I, p. 149) as follows:—"It is essentially aquatic, if such an expression be applicable to an animal which never enters water. It haunts that element continually, flying

so close to it that it is difficult to distinguish between the creature itself and its reflection. The flight, quavering and slow, is performed by very slight but rapid strokes of the wing; it may, indeed, be said to vibrate, rather than to fly, over the water."

So far it has not been recorded for either Somerset or Gloucestershire, but as it has a very wide distribution in the British Isles, and has been found in all but seven (including the two above-named) counties of England, it seems almost certain that it must be present.

The following dimensions are taken from Barrett-Hamilton, Vol. I, p. 148:—

Males.	HB 41-50.4	Ear 9.5-17.5	Forearm 33-38.5	Expanse 201-244 mm.
Females.	„ 43-51.0	„ 12-13	„ 35-39	„ 227 „

MYOTIS MYSTACINUS (Kuhl.) Whiskered Bat

The Whiskered Bat is small, like the Pipistrelle, from which it may be distinguished in the hand by the absence of a post-calcarial lobe in the wing and by the long attenuated tragus.

In the Bristol district it is widely distributed and evidently common locally. It is mentioned in *British Ass. Handbook to Bristol Neighbourhood*, 1898, p. 203, that "some hundreds were obtained at Willsbridge, near Keynsham," and the Rev. L. Blomefield (formerly Jenyns) in the *Zoologist*, 1888, p. 163, says that apparently it takes the place of the Pipistrelle near Bath and is often found in shops and houses.

There are definite records of its occurrence on the Somerset side of Bristol as follows:—

Lympsham, Cheddar and other Mendip caves, Litton, Claverton Old Rectory near Bath, Dundry, Ashton, Willsbridge near Keynsham, and Bath. Mr. M. Blackmore has never met with it at Stratton-on-the-Fosse and Downside Abbey, and Mr. Whish considers it scarce at Lympsham.

On the Gloucestershire side one was taken at Little Stoke, near Stoke Gifford, on September 6, 1933, and two were carefully identified at Dyrham Rectory by the Rev. F. L. Blathwayt on August 3, 1932 and July 21, 1933.

It seems likely from these data that the Whiskered Bat is locally more abundant than the Pipistrelle wherever there are caves, mine-workings, crevices in rocks, quarries, etc., to which it can retreat, and that away from these, and possibly at no great distance, the Pipistrelle may be the more numerous. Though he has records of this

Bat from Lympsham, which is only about $2\frac{1}{2}$ miles south of the Mendips, Mr. Whish finds it far scarcer than the Pipistrelle. All the Somerset localities mentioned either have caves, etc., on the site or close to, with the possible exception of Litton. As such retreats are so much more numerous on the Somerset than on the Gloucester side, it would follow that the Whiskered Bat might be more plentiful in the former, and it seems rather significant that the two Dyrham records come from a place situated on the edge of the Cotswolds where probably there are suitable fissures to which the Bats can go.

The following measurements are taken from specimens in the collections :—

Males.	HB 40	Tail 36	HF 6	Ear 16	Forearm 33.5	Expanse 222 mm.
	„ 43	„ 30	„ 7	„ 12	„ —	„ 212 „
	„ 42	„ 36.5	„ 8	„ —	„ —	„ 222 „
	„ 44	„ 32.5	„ 7	„ —	„ —	„ 210 „
Female.	„ 42	„ 32.5	„ 6	„ —	„ —	„ 210 „

MYOTIS BECHSTEINI (Kuhl.) Bechstein's Bat

The large ears of this Bat, though not as conspicuously long as those of the Long-eared, mark it off from all other British Bats. It is a very rare species in the British Isles, and is only mentioned as part of a skull was found in Avelin's Hole, Burrington Combe, one of the Mendip caves, and is now in the Museum of the Spelæological Society, University of Bristol. This was discovered at a depth of one foot in 1919-1921 and is of late Pleistocene age. (See Hinton, *Proc. Spelæological Soc. Univ. Bristol*, Vol. I, No. 2, 1920-1921, p. 74.)

The following measurements are taken from Barrett-Hamilton, Vol. I, p. 175 :—

HB 52	Ear 18-19	Tail 34, 35	Forearm 39-43	Expanse 248-252 mm.
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MYOTIS NATTERERI (Kuhl.) Natterer's Bat

Natterer's Bat is a small Bat, greyish-brown in colour above and whitish below, the line of demarcation being distinct. Its light colour and particularly the fringed interfemoral membrane will distinguish it from all other British species.

It has a wide distribution in the Bristol district, as the under-mentioned records show, but probably is not abundant anywhere :—

Somerset. Kingswood near Bath, spring 1874, in Bath Museum (*Vict. County Hist. Som.*, p. 163). Stone-quarries near Bath but rare (Rev. L. Blomefield, *Zool.*, 1888, p. 163). Lympsham, female, July 1, and male, September, both 1921. Wookey Hole, male,

November 20, 1920, and female, January 14, 1921. Cheddar, three males, December 28, 1920, March 31, 1921 and November 30, 1936. We are indebted to Mr. F. H. L. Whish for most of these records. Also from the Mendips are three males from Compton Bishop in 1933, two on March 18 and one on April 21.

Gloucestershire. Blaise Castle woods, female, on February 16, 1924, taken by Mrs. L. E. Currey. Dyrham Rectory, August 29, 1930, Rev. F. L. Blathwayt.

The following dimensions are taken from specimens in the collections :—

Male.	HB 43	Tail 44	HF 9	Ear 18	Forearm 39	Expanse	— mm.
"	" 42.5	" 41	" 8.5	" 16	" 38.5	"	257 "
"	" 47	" 35	" —	" 17	" —	"	270 "
"	" 47	" 34	" 7	" 13	" 38	"	260 "

PLECOTUS AURITUS (Linn.) Long-eared Bat

The enormous ears, 34 to 38 mm. long, serve at once to distinguish this Bat from all other British Bats.

The Long-eared Bat is probably generally distributed throughout the district and may also be common but I have little information about it.

In Somerset there are the following records :—Mr. P. Buxton (*Zool.*, 1907, p. 193) found them in the Cheddar caves, and reports them as occurring in Wells Cathedral. One was taken in a cave in Burrington Combe in March, 1933 by Mr. H. Audcent—this was hanging and not in a crevice—and another at Compton Bishop, March 19, 1933. Mr. M. Blackmore states that a small permanent colony is to be found in the roof of Downside Abbey, and that one was found on the wall of the parish room porch at Lympsham on October 6, 1933. Mr. Whish supplies me with the following records :—Lympsham, May 13, 1920, and June 6, 1923, both males. Cheddar, female, December 28, 1920, and, male, March 5, 1921. Nailsea, male, February 18, 1920.

On the Gloucestershire side of Bristol, a specimen from Pucklechurch, June, 1920, is in the collections, as is one from Henbury, November 12, 1934. One was found at Bristol University in March, 1935, and Dr. E. Barton White informs me that he has seen them hawking for moths on the verandah of his house at Fishponds, Bristol.

The measurements of three males in the collections are as follows :—

HB	41.5	Tail 43	HF 9	Ear 36	Forearm 39.9	Expanse	246 mm.
"	45.5	" 36	" 8	" 34.5	" —	"	262 "
"	40	" 41	" 8	" 35.5	" 38	"	262 "

BARBASTELLA BARBASTELLUS (Schr.) Barbastelle

This is a very dark, almost black, Bat with a slightly frosted appearance owing to light tips to the hairs, and slightly paler beneath. In addition to its dark colour, the internal margins of the ears are joined together, a feature only shared by the Long-eared Bat, the immense ears of which are very different.

It is rare in the Bristol district, but there are the following records :—
Somerset. Wells Cathedral. A. G. Berry, quoted by Millais (*Mammals*, Vol. I, p. 43), said that at that time (1902) a small colony existed in the roof. I can find no evidence that any number that can be called a colony exist there at the present day.

Wookey Hole. S. Lewis, *Zoologist*, 1906, p. 69 (the cave referred to is Wookey Hole). One was found there by Messrs. T. A. Coward and C. Oldham in January, 1907 (information per Mr. M. Blackmore).

Cheddar. One, March 28, 1921, F. H. L. Whish (Tucker, p. 97).

Gloucestershire. One at Tramways Centre, Bristol, 1898 (Rudge and Charbonnier, p. 57). One at Dyrham, August 29, 1930, another October 15, 1934 and a third on March 14, 1940. The first and third were fully identified by the Rev. F. L. Blathwayt, and the second was found dead by him and is now in the Bristol Museum collections.

The following dimensions are taken from Barrett-Hamilton, Vol. I, p. 217 :—

Males.	HB 45-52	Tail 40-48	HF 6-7-5	Ear 12-7-16	Forearm 36-39.
	Expanse 254-260 mm.				
Females.	HB 44-60	Tail 43-54	HF 6-7	Ear 13-5-16	Forearm 36-41.
	Expanse 268 mm.				

The measurements of the male from Dyrham, October 15, 1934, are as follows :—

HB 50	Tail 46	HF 7	Ear 15	Expanse 273 mm.
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RHINOLOPHUS FERRUM-EQUINUS INSULANUS Barr.-Ham.

Greater Horseshoe Bat

The two Horseshoe Bats are at once distinguished from all other British species by the nose-leaf on the face. The Greater is known by its size, the forearm never being less than 50 mm., whereas in the Lesser Horseshoe it is never more than 40 mm.

In the Bristol area it is a common Bat, particularly on the Somerset side where the caves on the Mendips form one of the chief, if not the principal, headquarters in the British Isles. It is, from the nature of the country, much more abundant on the Somerset than on the

Gloucester side, and, indeed, the only records we have for the latter are Clifton (Eagle Clarke) quoted by Millais (Vol. I, p. 25) and Westbury-on-Trym (Rudge and Charbonnier, p. 203). The record of "Frequent in the towers of Bristol Cathedral" given in the last-mentioned, p. 56, must now be completely altered. Within recent years steps have been taken to keep out the pigeons from the towers and the windows have been wired up, and the beams in the roof have been thoroughly treated to keep out or destroy destructive timber beetles. The result has been to drive away the Bats, and a thorough search by the author on May 23, 1933, failed to reveal a single specimen.

The Mendip caves are, as stated above, a well-known resort for this species, but in one at least, i.e. Wookey Hole, they are not, according to Mr. H. E. Balch, anything like as numerous as they used to be. This is almost certainly due to the great illumination used in recent years to light the cave for visitors. It has had the effect of driving away the Bats but does not necessarily imply anything more than local diminution in the numbers. A number are to be found in Wells Cathedral. There are also records for Somerset as follows:—Winscombe (Tucker, p. 97), Banwell, Dundry, Wraxall, Ashton, Clevedon, Hampton Rocks near Bath (abundant—*Vict. County Hist. Som.*, p. 164) and Bath (frequent in stone quarries near Bath—Rev. L. Blomefield, *Zool.*, 1888, p. 163).

It is evident that the Greater Horseshoe Bats are not always found in the same place throughout the year. One cave was visited in August and found to be empty; it was again searched thoroughly in November and was found to contain 40 of these Bats as well as two Lesser Horseshoe and one Whiskered. Mr. Wish has also found the same in the Lympsham district. In neither case has the summer retreat been found, but they may go into buildings, hollow trees or the ivy round trees. Even during hibernation, which is only partial, they move their quarters.

Of the 40 Bats examined in the cave mentioned above, 33 were in a colony hanging from the roof near the entrance. These were found to be males and females, and of the latter all were immature. There seemed to be a tendency for the sexes to keep apart as, of those examined first, there were more females than males, whilst the reverse was the case subsequently, but there was no very definite segregation. The remaining seven were solitary in various parts of the cave, and one adult female was found much deeper down in some workings.

Unlike most other Bats, the Horseshoes do not usually get into crevices but hang out in the open part of the cave, upside down and with the wings folded round them. They cling by their claws to the slightest crevice and it is remarkable to see the way they alight by suddenly turning a somersault in the air when close to the wall and catching on at once with their claws. No other British Bat has the same skill, and it seems possible that it is due to the nose-leaf of these two species which is a very efficient sense-organ.

On being disturbed by a light these Bats have a curious habit of pulling themselves up by bending the legs before taking to flight, and when on the wing their sailing flight is very noticeable.

The dimensions given are taken from Barrett-Hamilton, Vol. I, p. 236, for males, and from specimens in the collections for females:—

Males.	HB 60-67	Tail 30-36	HF 10-12.75	Ear 21-23	Forearm 51-54.5.	Expanse 312-342 mm.
Females.	HB 69	Tail 35	HF 11	Ear 25	Forearm —	Expanse 358 mm.
	" 67	" 34	" 11	" 25	" —	" 360 "
	" 60	" 33	" 10	" 23	" —	" 356 "
	" 66	" 36	" 12	" 25.5	" —	" 370 "

RHINOLOPHUS HIPPOSIDEROS MINUTUS (Mont.)

Lesser Horseshoe Bat

This Bat is distinguished from the Greater Horseshoe by its smaller size, and also by differences in the central portion, or sella, of the nose-leaf.

In the *Victoria County History of Somerset*, p. 164, it is described as "Local and scarce," and in *Brit. Ass. Handbook to Bristol Neighbourhood*, 1898, p. 203, as "Somewhat rare, and has seldom been recorded north of the Avon." In 1909 Messrs. Rudge and Charbonnier (p. 56) gave "Generally distributed in caves, etc."

The last is certainly correct at the present day. It is found in all the caves where the larger species has occurred, as well as in Wells Cathedral. Undoubtedly it is more numerous on the Somerset side of Bristol, owing to the greater amount of suitable shelter, than it is on the Gloucestershire side. But in the latter we have records for Westbury-on-Trym (March), Kingsweston (December), Henbury (July), and Dyrham (September). One colony was examined in the roof of a Manor House near Bath in July, 1940. This consisted of 41 females carrying young, and one male. The following dimensions are taken from specimens in the collections:—

Males.	HB 36	Tail 22	HF 7	Ear 16	Expanse 225 mm.
	" 40	" 23	" 7	" 15	" 227 "
	" 38	" 25	" 9	" 16	" — "
Females.	" 40	" 22	" 6	" 15	" 228 "
	" 42	" 23	" 8	" 14	" 242 "

IV. INSECTIVORA

ERINACEUS E. EUROPÆUS Linn. Hedgehog

The Hedgehog is abundant throughout the area. It is noticeable that numbers get run over by motor vehicles in the autumn.

TALPA EUROPÆA Linn. Mole

Common throughout the area. One of the interesting points about the Mole is the great variation that may be found in its colour. True pink-eyed albinos are almost or quite unknown, but there is every range from the normal colour to cream-coloured specimens with normal coloured eyes. In the Bristol district a number of these varieties have been met with, and it seems worth while to give some details. So far I have no records of variation on the Gloucestershire side of Bristol.

In Somerset they are found in certain areas. Dr. L. H. Matthews, in doing some research on the anatomy of the Mole, handled just over 300 of these animals all caught near Portishead, and none of these showed any variation, with the exception of one that had a white tip to its tail. On the other hand, varieties are fairly numerous on the levels of the Brent Knoll district, as the following known records show:—

1. Female. Bleadon, December 1, 1919.

Pure white above, inclining to cream at the tip of the fur; orange-brown beneath in mid-line expanding on chest and belly and intensified on the throat. The hair about 10 mm. long on the dorsal surface.

2. Male. Wick, Lympsham, October 4, 1926.

Cream above, intensified to orange-brown beneath, particularly on the throat and snout. The hair about 6 mm. long on the dorsal surface.

3. Male. Lympsham, November, 1926.

The general appearance above is normal colour, but mottled by the light bases of the hairs showing through in places; beneath it is varied by orange-brown. The latter colour predominates on the throat and belly to

the exclusion of the dark tips, the dark colour prevailing on the chest. The hair is about 10 mm. long on the dorsal surface.

4. Male. Brent Knoll station, July 19, 1933.
Cream-coloured.
5. ? Edithmead, January, 1934.
Deep black all over except on breast and belly where central portion is of apricot merging into deep orange posteriorly.
6. ? Edithmead, January, 1936.
Similar to No. 5.

Nos. 1, 2 and 3 are in Taunton Museum, No. 4 in Bristol Museum, Nos. 5 and 6 in private hands.

In addition to these Mr. Roger Ford described in the *Zoologist*, 1882, p. 263, one trapped near Wraxall in February, 1882, that was of a pure cream colour, the underparts being light brownish red, and a second, "bought some years ago," of normal colour with two white or nearly white spots on the back. The latter specimen Mr. Ford has recently presented to Bristol Museum, and he informs me that it was caught by a mole-catcher near Wraxall between 1869 and 1882, but he has no record of the exact date. The details are as follows:—

On the upper surface from just behind the shoulders to the root of the tail is the normal colouration with the exception of two areas of whitish fur in the middle of the back. Of these the most anterior is about 13×17 mm. and is separated by a very narrow (2 mm.) strip of black fur from a large, somewhat irregular area, 62×20 mm. which reaches nearly to the base of the tail. These areas consist of very long (9 mm.) white hairs in striking contrast with the very short (5 mm.) normal-coloured hairs alongside. The shoulders above and below, as well as the head and snout, are a dirty whitish colour, with the exception of a brownish patch between the eyes. This whitish colour is continued on the flanks as a gradually lessening streak which merges into the normal colour about 40 mm. behind the forelimb. The normal-coloured hair, in addition to being very short, is also harsh to the touch, and it would seem that this short hair represents new hair freshly moulted and that the long white hairs represent the remains of the old coat. In other words, that an abnormally coloured Mole may not remain so all its life but may change its coat at the next moult.

Grey varieties have also been met with, as Mr. Whish informs me. He remembered having some from the Lympsham district about 20 years ago, but he has no record of the exact date.

SOREX ARANEUS CASTANEUS Jenyns Common Shrew

This animal, though not often seen, is very abundant and probably the commonest mammal in the district. On practically every occasion when trapping has been carried out, more Common Shrews have been caught than any other animal, and this applies equally to the two counties. It is, however, worth noting that, in the details of the Barn Owl pellets given in the Preface, this Shrew, though second in numbers of the bird's victims, comes considerably below the Field Vole (18 to 116) though trapping gave a very different result of 12 Shrews to one Field Vole.

Taking specimens all the year round, the average measurements for 10 males is HB 68.3 mm. and for 12 females 63.7 mm., the highest figures for both sexes being recorded in August as follows:—

Male.	Nailsea 30.VIII.1933.	HB 75	Tail 33	HF 12	Ear 5 mm.
„	„ 30.VIII.1933.	„ 74	„ 33	„ 12	„ 5 „
Female.	„ 21.VIII.1933.	„ 68	„ 40	„ 12	„ 4 „
„	„ 12.X.1933.	„ 67	„ 37	„ 12	„ — —

All these measurements fall considerably below the maxima of 84 mm. for both sexes (in one specimen, Scotland, 88 mm.) recorded in Barrett-Hamilton, Vol. II, p. 92, but they are taken from 31 skins.

It is well-known that the colour of the Common Shrew is liable to a great deal of variation. Typically, it has a short coat of a grizzled "mummy brown" in summer, and a longer one, very deep seal brown in winter, the flank band at the latter season being much more clearly marked than in the former. From these types there are many variations, and as the cause is not understood, it seems useful to give details of skins in the collections, all of which were taken in the district.

April. Female—HB 65, Tail 40, HF 12 mm. (Measurements from skin.) Pale brown above, paler flanks and below.

Male—HB 80, Tail 36, HF 9 mm. Dark brown above, paler below and on flanks.

May. Two males and one female. The female is the lightest of the three and the two males are still apparently in winter coat.

July. Five females and three males with pale brown short coat in both sexes. One male (Reg. No. Ab 1696) is deep brown on back

and has a large white patch on the right shoulder and scattered white hairs on the snout ; the flanks are brown with a very distinct line of demarcation.

August. Five females, six males, one sex ?. All females are uniform pale brown ; four males are the same, one male (Reg. No. Ab 1714) is darker brown above, another (Reg. No. Ab 1715) is still darker above and the fur is very glossy, the flanks are lighter and very distinctly marked off, the fur of the back is short with scattered white hairs. It is an adult HB 75 mm.

September. Two females, one brown with scattered white hairs and white ears, the other dark especially on the rump, and with a small white patch between the shoulders.

October. Seven females and six males. Of the females four are in deep brown winter fur, two of the others are moulting ; one has a patch (25 mm.) of dark fur on the back and the other of about 50 mm. from the base of the tail, and the third is brown, slightly darker on the rump. Three males are brown to pale brown, and three are deep brown. One of the former is moulting in a peculiar way, a wedge of darker fur from the shoulders backwards nearly meeting a wedge of the same colour from the tail forwards in the middle of the back. The other two are slightly darker on the rump.

November. Two females strikingly different, one being pale brown with a short coat, and the other deep seal-brown with a long coat, the flanks being very marked in the latter and very indistinct in the former.

December. One male in moult with a patch of dark brown fur about 25 mm. long over the hindquarters, the rest being brown and the flanks not very distinct. It has white hairs on the ears.

In the above, only local specimens have been considered and, with regard to the November skins, the variation in winter is confirmed (*in litt.*) by Mr. R. I. Pocock who trapped in Leigh Woods two Common Shrews, one very nearly black and one light fawn, on a ground wet with snow at Christmastide.

As two of the summers (1933 and 1934) during which this work has been carried out have had long spells of hot sunny weather, it seems worth while to examine the skins and see how far they corroborate Adams' experience quoted in Barrett-Hamilton, Vol. II, p. 639, that, in the sunny summer of 1911, he found the coats of Common Shrews lighter.

in colour than usual, and that there was much more albinism in the ears: "about 25% had white ears in that year, whereas about 4% is the normal condition." Out of 26 skins taken in the former year (1933) (5 July, 12 August, 1 September, 8 October) 7, i.e. 2 July, 4 August, 1 September, 0 October, had white or partly white ears, giving a percentage of 26.9. The colour of the coat was not universally light, one taken on August 30 having the deep seal-brown of winter.

Exceptional variations and moulting specimens have been noticed above, and in addition, an albino from Winscombe (Reg. No. 4.8.9.1.) is in the collections of the British Museum (Natural History).

In the autumn, Shrews are commonly found lying dead without sign of injury. It has been suggested that this is due to animals such as cats, weasels, etc. killing and then dropping them owing to their unpleasant taste, but a much more likely view is put forward by L. E. Adams (quoted in Barrett-Hamilton, Vol. II, p. 108) suggesting, with good evidence, that the normal life is only twelve months and that the animals have died normally. This has been definitely shown to be the case by F. W. Rogers Brambell (*Phil. Trans. Roy. Soc.*, B 225, pp. 1-62, 1935).

SOREX M. MINUTUS Linn. Pigmy Shrew

The Pigmy can be distinguished from the Common Shrew by its smaller size and by its thicker and more hairy tail which is actually and relatively longer. The teeth also differ.

It is locally abundant in both Somerset and Gloucestershire and is found in scattered colonies.

In the *Victoria County Hist. Somerset* (p. 164) it is described as "rather uncommon and local. It occurs in the Leigh Woods near Bristol." Rudge and Charbonnier (p. 57) say "It . . . is uncommon with us, but it has occurred in the Leigh Woods and a few other localities."

Specimens in the collections have been taken, in Somerset, at Cheddar, Lympsham, Portishead, Nailsea and Brean Down, and in Gloucestershire at Hallen Marsh and Little Stoke, the last being part of a skull found in the pellet of a Barn Owl. Mr. Pocock also informs me (*in litt.*) that a number of years ago he trapped specimens in Leigh Woods and Clifton. They have, in fact, been taken wherever trapping has been carried out, though not on every occasion; and as, in certain

instances, they are known to be restricted to small areas and cannot be caught outside them, it seems likely that they live in local colonies.

Measurements of skins in the collections are as follows:—

Males.	Average of 12 skins.	HB 55.5 mm.
Females.	„ „ 7 „	„ 50.4 „

Details of the largest specimens are as follows:—

Male.	Portishead, April	HB 60	Tail 37	HF 10	Ear 4 mm.
„	„ March	„ 60	„ 36	„ 10	„ 5 „
„	„ April	„ 58	„ 34	„ 10	„ 5 „
„	„ March	„ 59	„ 37	„ 10	„ 4 „
Female.	„ March	„ 55	„ 35	„ 9	„ 4 „
„	„ April	„ 55	„ 34	„ 10	„ 5 „
„	Lympsham, Nov.	„ 52	„ 39	„ 11	„ 5 „

NEOMYS FODIENS BICOLOR (Shaw) Water Shrew

The Water Shrew is bigger than either the Common or Pigmy Shrews, and the long tail and feet are distinctly “feathered” for swimming. The colours are different, being strongly contrasted black (above) and cream (below), and the skull and teeth are distinct.

It has been recorded in the Bristol district as follows:—

Somerset. Bleadon, Cheddar and Chewton Mendip (Tucker, pp. 98 and 99), Nailsea Moor, Lympsham and Portishead (specimens in the collections).

Gloucestershire. Frampton Cotterell and Westbury-on-Trym (Rudge and Charbonnier, p. 58).

It is probably local but widely distributed.

The measurements of the largest examples taken are as follows:—

1. Male.	Portishead, July	HB 70	Tail 50	HF 16	Ear 4 mm.
2. „	Nailsea, August	„ 78	„ 52	„ 17	„ 7 „
3. Female.	Portishead, March	„ 82	„ 45	„ 16	„ 4 „
4. „	Nailsea, August	„ 80	„ 47	„ 15	„ 7 „

Of these, No. 3 (Portishead, March 5, 1933) and No. 4 (Nailsea Moor, August 21, 1933) call for some remarks. The former has the coat grizzled all over, and especially on the shoulders and head, giving it a whitish-grey colour; and the underparts are strongly washed with yellow. In the skull the teeth are very worn, so much so that the red colouration characteristic of the tips of the teeth of these Shrews only appears as a minute speck on the upper incisors and on the front molar. Evidently a Water Shrew grizzled from age. The latter is in moult, the head, shoulders and base of the tail being of the normal colour and enclosing a large saddle of brown.

V. RODENTIA

LEPUS EUROPÆUS OCCIDENTALIS de W. Hare

The Hare is generally distributed throughout the district and is common in places. But its numbers are so dependent on human interference that it is difficult to give any precise data as these may be largely artificial due to preservation or the reverse. It is found plentifully both on the low-lying ground and at a higher elevation as well. I have not received any evidence of epidemics, though Hares are said to be scarce after wet summers. They were said to be especially abundant near Pensford in 1933 and 1934, both of which were unusually dry and hot during the summer months.

ORYCTOLAGUS C. CUNICULUS (Linn.) Rabbit

The Rabbit has a wide distribution throughout the district, and is very common in many parts.

A number of varieties have been seen or heard of, e.g. black ones at Tortworth Court in July, 1934, and also near Cambridge Batch in 1933. Mr. Whish informs me that the same occur in the Lympsham area as well as the following variations: dark brown, several pure white with brown eyes from near Loxton, and one albino.

Rabbits, in common with other Rodents, are liable to great increase followed by a sudden fall in numbers due to an epidemic, after which the numbers rise again—a cycle which probably occurs at regular intervals. In the Bristol district there is evidence of this in North Somerset. About 1929 there was a great epidemic on the Upper Farm estate, Abbots Leigh, and hundreds of dead ones were found. In 1933 they were as numerous as ever, but another epidemic occurred in the winter of 1935-1936, large numbers being picked up dead. The late Dr. E. T. Glenny informed me that on Cadbury Camp Rabbits were an absolute plague a few years ago (written in 1933) and everything had to be closely wired to keep them out. Then a very striking change occurred, mostly about 1930-1931, the numbers went down rapidly and no precautions were necessary. In this case, however, he did not notice any sign of disease.

SCIURUS VULGARIS LEUCOURUS Kerr Squirrel

The Squirrel is probably less plentiful in this district than it was 25 years ago. Writing in 1909, Messrs. Rudge and Charbonnier de-

scribed it as "... plentiful wherever woods and plantations are found. The Squirrel may often be seen in the woods round Henbury and Kingsweston."

At the present day it is certainly widely distributed throughout the Bristol area, so that it is not necessary to name localities. But, on the Somerset side, Mr. B. W. Tucker (p. 100) considered, from reports sent in, that "a very general and widespread decrease of Squirrels appears to have taken place in recent years." At Alveston, north of Bristol, Captain R. L. Matthews finds them almost extinct.

It is well-known that, wherever forestry is carried on, this Squirrel may have to be controlled owing to the damage it does to young trees, and at one time such steps had to be taken at Tickenham. But at present action is not considered necessary as the Squirrels are not sufficiently plentiful to warrant it.

A striking example of the damage Squirrels can do to trees was provided on the Tortworth Court Estate. Here, box trees, just over $2\frac{1}{4}$ inches in diameter and of a surprising hardness and weight, had been cut all round in strips about one inch long and forming an incomplete ring. The whole of the bark had been cut through in this way, and the rings extended from about one foot from the ground to some distance up the tree. Though no doubt the work of Squirrels, it is not possible to say whether it was the work of the native species or of the imported Grey, both of which are found on the estate.

The only instance of variation of colour of which I have any record is of two albinos killed in 1893 on Captain Holford's estate at Westonbirt, Tetbury, Glos. The male was shot on September 11 and the female on October 2 (*Zool.*, 1893, pp. 426, 497).

The undermentioned figures will give an idea of the dimensions of this Squirrel:—

Male. Suffolk, January. HB 243 Tail 160 HF 55 Ear 30 mm.

SCIURUS CAROLINENSIS LEUCOTIS (Gapper) Grey Squirrel

The Grey Squirrel is a native of Eastern North America and has at various times been introduced into the British Isles.

The typical speckled grey with a saddle of pale brown distinguishes the adult at once from the native Red Squirrel, but it is also a considerably larger and heavier animal, and does not develop ear-tufts as the other species does in winter. In the late summer and autumn it has a distinct reddish tinge along the flanks while the upper parts

of the feet are bright reddish-chestnut; this mixture of red and grey has led to the idea that such specimens are hybrids between the Grey and Red Squirrels, but it is simply a seasonal phase of the Grey and there is no foundation for such a suggestion.

Owing to the wide range of its food and its active habits, its numbers should be reduced in every possible way. It will strip the bark off deciduous trees, eat many kinds of fruit such as peaches, apples, pears, gooseberries, tomatoes, etc., and has been observed to eat growing wheat.

Its relations with the Red Squirrel are not altogether certain. Though, as one head keeper has told me, a Grey Squirrel has been seen to attack a Red and would probably have killed it had he not intervened, the undoubted disappearance of the Red in many places where the Grey has come may be due, not to this hostility, but to a regular cycle of disease by which the numbers of many Rodents are controlled in nature. From observations made by the same keeper in one area of woodland, it would seem that hostility between these two animals is only noted in winter.

Full details are given below of the history of their distribution in the Bristol area, and one interesting point may be noted, viz. that in the autumn the males are given to wandering apparently in search of fresh quarters. All the Gloucestershire specimens are males, as are two from Somerset, and all were killed between September and November in places that were, at that time, isolated from any invasion of the Grey Squirrel. The Gloucestershire specimens are also remarkable in that two of them were shot in the same isolated walnut tree though at an interval of about two years, while the third one, in the following year, was killed only about two hundred yards away. Details of distribution are as follows:—

Gloucestershire. At Tortworth Court (17 miles N.N.E. of Bristol) there are a large number as well as a number of Red Squirrels. Two Grey Squirrels recently shot were examined there in July, 1934, and there were three or four others that had been killed during the preceding months.

At Alveston (9½ miles N.N.E.) Captain R. L. Matthews informs me that he saw one at very close range about August 28, 1933, but it disappeared later.

On the Over Court estate (8 miles N.) a pair were seen in the spring of 1932 by Mr. W. C. Taunton, and a single one later.

A male was killed in a walnut tree at Pilning (7 miles N.W.) on September 12, 1938.

One was shot at Bailey's Court, Stoke Gifford ($5\frac{1}{2}$ miles N.N.E.) on November 1, 1933, when it was in a walnut tree. This may possibly be the same as the one seen at Alveston in August of that year. Another was shot in the same tree on October 1, 1935, and a third about 200 yards away on September 20, 1936. All three are males and have been referred to above.

In Savage's Wood, close by, three or five were seen in the late summer of 1937, this being the first occasion on which they had been noticed. About the same number were seen on November 27, 1937, by Mr. H. H. Davis, and not fewer than nine, of which about six were killed, in May and June, 1938.

In the woods of Blaise Castle ($4\frac{1}{2}$ miles N.N.W.) Mr. F. R. Willcox recollects seeing Grey Squirrels in 1927, though he has no record of the exact date. Later, on December 3, 1933, he saw one Grey and two Red Squirrels, and one was shot about the end of 1932. During the winter of 1934-5 it was not unusual to see from twelve to twenty in one part of the woods, and in the summer of 1935 five or six young with parents were observed. Since then, numbers seem to have kept up, or even increased, and steps are being taken to control them.

On the edge of the Cotswolds at Dyrham (10 miles E.) there were none up to 1936, while in Badminton Park (13 miles N.E.) there are a few as well as a large number of Red Squirrels.

In August, 1930, the author saw a Grey Squirrel crossing the road on Lower Clifton Hill, Bristol. This was for some years the most southerly example noted and the one nearest to Somerset.

Somerset. The first definite record for the county was by Mr. Stanley Lewis, who informed me that one was shot in Old Draycott Wood, near Cheddar, in August, 1935; this was examined in the following year. The undermentioned specimens are in the collections:—

Male.	Whitchurch, near Bristol.	October 11, 1936.
"	Blackford, near Wedmore.	" 5, 1936.
?	Belmont Hill, Long Ashton, Bristol.	" 2, 1937.
Male.	Kelston, near Bath.	" 18, 1937.

In addition, one was seen in the grounds of Leigh Court by Mr. J. H. Savory on March 26, 1937, at about two miles from where the one was killed on Belmont Hill in October.

From the above data it will be seen that the Grey Squirrel was

on the Gloucestershire side of Bristol considerably before it was in Somerset. From the north it came down the Severn Valley from the direction of Cheltenham, and the rapid spread in recent years has been much more pronounced on the western low-lying ground than on the higher eastern country. It is significant to compare Tortworth Court and Badminton Park, both of which seem very suitable for Squirrels, yet the population of Grey Squirrels in the former is far larger than it is in the latter. In Somerset it has appeared from the east, coming from the Bath area and along the southern slopes of the Mendips. It is now widespread throughout the area.

In their native country, Grey Squirrels at times undertake great migrations from some highly-populated (by Squirrels) area. They then travel long distances, even swimming rivers and lakes. At present the Squirrel population to the north of Bristol does not seem sufficient to warrant such migrations, but it is an interesting fact that, to a great extent, the trend of the spread from the centres of introduction in southern England has been in a westerly far more than in an easterly direction, and, as far as one can tell, this seems to have come about by the migration of a pair of Squirrels which founded a colony, no large scale migration having been recorded from this country. The details given above, particularly from the Stoke Gifford area, suggest that it is the males which, by wandering in the autumn and finding fresh quarters, increase the range of these animals.

Details and measurements of specimens in the collections are as follows :—

Male.	Stoke Gifford.	17.VI.1938	HB 292	Tail 210	HF 60	Ear 30 mm.
"	" "	1.XI.1933	" 280	" 210	" 58	" 32 "
"	Whitchurch, Som.	11. X.1936	" 276	" 192	" 45	" 33.5 "
"	Kelston, Bath.	18. X.1937	" 262	" 188	" 60	" 27 "
"	Stoke Gifford.	1. X.1935	" 250	" 220	" 60	" 30 "
Female.	" "	21. V.1938	" 255	" 197	" 60	" 31 "

MUSCARDINUS AVELLANARIUS (Linn.) Dormouse

The Dormouse is easily distinguished from all other British Mammals by its reddish colour and long hairy tail.

In the *Victoria County Hist. Som.* (p. 165) it is described as "local, but sometimes in plenty in Claverton Woods, near Bath, and at Portbury near Bristol." Rudge and Charbonnier (p. 59) give "fairly common, but local, mostly in nut woods." There is not very much information to add to this.

Mr. H. C. Baker informs me that he found one hibernating near

Abbots Leigh in the autumn of 1932, and at various times others in that neighbourhood, as, for example, on October 5, 1933, one about three-quarters grown in a young larch plantation. A man who was rabbiting discovered one hibernating in a nest at Tickenham on December 26, 1933.

Indirect evidence of their presence is afforded in the finding of hazel nuts which had undoubtedly been opened by Dormice in a wood near Portishead. Dormice open these by a neat circular hole very different from the haphazard hole made by the biting of other mice.

"Possibly common locally" would express its distribution at the present day as far as it is known to me. In *Brit. Ass. Handbook to Bristol Neighbourhood*, 1898, p. 200, it is said to be more frequent on the Somerset than on the Gloucestershire side of Bristol, and this is no doubt the case owing to the greater supply of woodland in the former county.

The following dimensions are taken from Barrett-Hamilton, Vol. II, p. 361 :—

Males	HB 71, 75	Tail 68	HF 16, 18	Ear 13 mm.
Females	„ 73-85	„ 55-62	„ 15, 16	„ 11, 12 mm.

MICROMYS MINUTUS SORICINUS (Herm.) Harvest Mouse

The Harvest Mouse is distinguished by its small size, bright reddish colouration above and sharply contrasted white beneath, and long prehensile tail.

It has for long been considered rare and local in this district, and the only information I have about it at the present day is that it is believed, on good authority, to occur near Wells. I have no record of its occurrence anywhere else.

The following dimensions are taken from a skin in the collections (the animal was taken in Surrey) :—

Female.	10.IV.1926.	HB 61	Tail 54	HF 13	Ear 11 mm.
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APODEMUS S. SYLVATICUS (Linn.) Field Mouse

The only other British Mouse with which this species can be confused is the House Mouse, but, apart from differences of habitat (represented by their names) in which they are usually found, the Field Mouse is redder above and whiter beneath with a distinct line of demarcation between the two. The hind-foot is much larger, and the incisor teeth lack the very distinct notch on the hinder edge which is so characteristic of the House Mouse.

The Field Mouse is very common throughout the district. It is doubtful if it is more plentiful than the Common Shrew, trapping on nine occasions giving 57 of the latter against 32 Field Mice, and both animals are very easily caught.

Certainly it does not warrant the name of Wood Mouse, which is given to it in some parts of England. It has been caught on open ground away from any trees, and on one occasion, when fields and a wood were trapped, the traps in the latter caught very little though six of these mice were captured elsewhere. Field Mice will occasionally enter dwelling-houses, and Mr. B. W. Tucker (Tucker, p. 99) records trapping several in his house at Chewton Mendip in the winter of 1925-1926.

During an examination of about 68 pellets of the Barn Owl (*Tyto a. alba*) taken from the same locality in January, March and November, ten skulls of the Field Mouse were found in a total of 181 skulls, this Mouse thus forming 6% of the food of this pair of birds. The country is flat, with pastures, etc. and one area of woodland.

The colour varies through the year, and after studying 45 skins, I find that the reddest ones are those taken between December and April in their winter coat. The remainder are a greyer-brown with the exception of a female (HB 95 mm.) taken at Little Stoke, Glos., on August 26, 1933, which is distinctly reddish.

Those from Portishead and Lympsham all show a reddish-brown colour, and in the former the dorsal dark marking is conspicuous. The three from Nailsea Moor differ obviously in their grey-brown colour without any trace of red. The Brean Down mice are distinctly sandy and without, in the largest specimens, any dorsal mark. Those from Wavering Down are reddish-brown but the Yellow-necked Mouse (Nov. 25, 1934) does not differ from the others in dorsal view.

The few Gloucestershire mice are a mixture, especially those, all females, from Little Stoke. One is very reddish while another is a greyer-brown above but is fully adult as the teeth are very worn. These were all caught on July 26, 1933.

There is one variety in the collections, viz. a female from Portishead (Jan. 8, 1933) which has a median white spot on the dorsal surface, just behind the shoulders. A buff female, black hairs entirely absent, from Brent Knoll (Reg. No. 3.12.17.1 of British Museum collection, Percival) is in the British (Natural History) Museum collections and is mentioned in Barrett-Hamilton, Vol. II, p. 514.

The average measurements (excluding all those under 80 mm.) are for 11 females 89.3 mm., for 9 males 89.4 mm., the largest being as follows :—

Male.	Nailsea Moor, August.	HB 98	Tail 85	HF 22	Ear 16 mm.
"	" " " "	" 95	" 82	" 21	" 15 "
"	Portishead, March.	" 95	" 80	" 20	" 15 "
Female.	Little Stoke, July.	" 95	" 90	" 22	" 15 "
"	" " " "	" 95	" 75	" 20	" 15 "
"	Portishead, November.	" 93	" 82	" 20	" 15 "

APODEMUS FLAVICOLLIS WINTONI (Barr.-Ham.)

Yellow-necked Field Mouse

"The Yellow-necked Field Mouse is distinguished from *A. sylvaticus* by its larger size (head and body of adults 100 to 115, hind-foot 23 to 27, condylo-basal length of skull 25 to 28.8 mm.), more intense and purer colouration, and by cranial characters" (Barrett-Hamilton, Vol. II, p. 547).

The British sub-species, also called de Winton's Field Mouse, "usually possesses a well-defined and complete ochraceous breast-band or collar about 8 mm. broad," etc. (*loc. cit.*, p. 549).

Any large Field Mouse with a complete and broad yellowish band across the chest will probably belong to this species. The common Field Mouse often has a pectoral spot of this colour, but it is not so complete or so broad, nor does it reach so large a size.

The only record for this district is of a female taken by Mr. Stanley Lewis on Wavering Down, Mendips, on November 25, 1934. As stated in the account of the Field Mouse, this specimen does not differ obviously in colour in a dorsal view, but, beneath, its most striking characteristic is a broad band of yellowish-brown across the chest. It is also the largest Mouse in the collections, the measurements being as follows :—

HB 102 Tail 98 HF 22 Ear 17.5 mm.

It may be mentioned that this is the only one of 19 specimens, not all of which could be preserved, taken on Wavering Down in October, November and December, 1934, which showed any sign of a yellow band across the chest. They were all trapped on limestone outcrop.

MUS MUSCULUS MUSCULUS Linn. House Mouse

Very common everywhere in houses, outbuildings, etc. As the Field Mouse may occasionally be found in houses, the following details are given for the identification of the House Mouse. It is grey-brown

above, passing gradually into slaty colour beneath, and there is no line of demarcation between the two. In the skull the incisor teeth have a very distinct notch on the hinder edge.

The measurements of a skin in the collections are as follows:—

Male. 15.III.1933. HB 80 Tail 64 HF 16 Ear 13 mm.

RATTUS RATTUS (Linn.) Black Rat

It may be as well to explain first that colour is no guide in distinguishing this Rat and its races from the Brown Rat as there are brown races of the former, and a black variety of the latter, though none of these have been found in Bristol so far.

The chief distinctions are in the lighter build, sharper muzzle, much longer ears and longer tail, the latter being always longer, and usually very much more so, than the head and body combined, all of which are characteristic of the Black Rat.

Judging from a note in the *Zoologist*, 1893, p. 19, sent in by Mr. Charles Garnett of Rownham House, the Black Rat was rare in Bristol at that time. If that is correct, and there seems no reason to doubt it, it has certainly increased considerably in the last forty years. In the *Victoria County Hist. Som.* (p. 165) Mr. H. J. Charbonnier describes it (in 1902) as "Local. Occurs on the Somerset side of the Bristol Avon in warehouses and factories." Seven years later (1909, p. 59) he says "it still occurs, sometimes commonly, in Bristol warehouses and factories."

The following figures will show that there is at the present time quite a considerable population of Black Rats in the immediate neighbourhood of Bristol, and that they are also to be found in Somerset at the Portishead Docks. It must be remembered in reading these records that they only refer to those recovered in the course of trapping, poisoning, etc. by the official ratcatcher, and there must be many others which are not found, particularly of those poisoned.

Period July, 1929, to end of 1934

A.	Bristol City	..	..	..	..	1817
B.	Bristol Docks and Quays	..	..	..	..	2436
Total for Bristol						4253
C.	Avonmouth Docks and Quays	..	..	..	..	4804
D.	Portishead Docks (to 1932 only)	..	..	..	..	144

In Bristol the highest number recovered was in 1932, viz. 452 for the City and 712 for the Docks and Quays, or a total of 1,164. The

greatest jump in the former (260 to 452) occurred between 1931 and 1932, and in the latter (313 to 685) between 1930 and 1931. But it is difficult to say whether this was due to a great increase in the number of rats, or to improved methods of catching them.

The habits of the two species are very distinct. The Black Rat is far more agile and shuns the neighbourhood of water much more than the Brown. As regards agility, where both species are found under the same roof, as in the granaries at Avonmouth, the Black Rat occurs in the top floors of the buildings, the Brown Rat on the ground-floor, and the former have been noticed at night in Bristol crossing from one building to another along the telephone wires. It is by such means that they can spread from one "rat-proof" building to another unless proper means are taken to prevent their doing so. There is no doubt that they can also get about the city in crates, packing-cases, etc., for in two instances, as Mr. Ryman is good enough to inform me, this actually occurred. On one occasion one had got into a piano-case from the Continent through a hole caused by a knot in the wood, and on another some Rats escaped from a roll of paper, the central portion of which was hollow.

This Rat and its races are the common ship rats, the Brown Rats occurring very rarely on board according to experience at Avonmouth, and, though strict regulations are enforced, such as fumigation, etc., it is obviously impossible to prevent some getting ashore. It thus seems likely that in a shipping centre such as Bristol and Avonmouth, the Black Rat has come to stay.

While the Black and Brown Rats do not and cannot interbreed, the three races of the former can and do interbreed so that many intermediate types occur. But all the same, it is usually possible to identify an adult Rat as belonging to one of the three races.

As would be expected, the greatest number of these animals in Bristol are caught in the immediate neighbourhood of the Docks. They are not, apparently, found more than about $1\frac{1}{2}$ to 2 miles from the centre of the city. In view of the spread of the city in recent years it will be as well to record that, though they have been found on the Gloucestershire side up to Blackboy Hill, Clifton, the Downs seem to form a barrier beyond which they do not occur, and, Mr. Ryman informs me, all the rats caught at Shirehampton are Brown Rats. It will be of interest to see if this distribution alters at all in the future. in view of the proximity of the docks at Avonmouth.

The above remarks apply to all three races of *Rattus rattus* subject to any modifications given below.

RATTUS R. RATTUS (Linn.) A.—Black Rat

This sub-species, or race, is distinguished by black colouration above and deep slate beneath. It occurs commonly on ships and in the vicinity of the Docks.

The measurements of the largest one in the collections are as follows :—

Male. Victoria Street, Bristol, 28.IX.1936. HB 212. Tail 223. HF 35. Ear 25 mm.

RATTUS R. ALEXANDRINUS (Geoffr.) B.—Alexandrine Rat

This rat is distinguished by greyish-brown colouration above and smoky-grey beneath, with no distinct line of demarcation between the two. It is by far the rarest of these Rats, either in the city or on ships.

The measurements of four in the collections are as follows :—

Male.	Flour Mills, Bristol.	29.I. 1934.	HB 188	Tail 190	HF 33	Ear 22.5 mm.
„	Avonmouth Docks.	18.XII.1935.	„ 178	„ 211	„ 34.5	„ 23 „
Female.	Clifton.	20.IV.1934.	„ 192	„ 205	„ 35	„ 23 „
„	Avonmouth Docks.	31.I. 1933.	„ 210	„ 205	„ 35	„ 22 „

RATTUS R. FRUGIVORUS (Rafin.) C.—Tree or Roof Rat

The typical ship rat, distinguished by greyish-brown colouration above and lemon beneath, usually sharply marked off. It occurs commonly, and particularly on ships.

The measurements of the largest examples in the collections are as follows :—

Male.	Avonmouth Docks.	28.XI.1932.	HB 220	Tail 220	HF 36	Ear 22 mm.
Female.	Union St., Bristol.	18.II. 1933.	„ 210	„ 220	„ 32	„ 22 „

Apart from the normal variation expressed in the three races mentioned above, the only variation noted is of a fawn variety, but as this is of particular interest further details are given. It is an immature male (HB 129 mm.) taken on a lighter at Avonmouth on December 3, 1935, and is now in the collections. The whole upper parts are fawn, shading to a lighter colour beneath; the colour of the eyes is normal. No such variety was known until it turned up in some breeding experiments carried out by J. L. Bonhote some thirty years ago (*Proc. Zool. Soc.*, 1910 and 1912). He crossed *R. r. frugivorus* with *R. r. alexandrinus* and found that the results of his first cross were apparently pure *frugivorus*. But when two of the latter were crossed the result was

17 *frugivorus*, 5 *alexandrinus*, 7 fawn *frugivorus* and 1 fawn *alexandrinus*. No doubt the specimen from Avonmouth had come about in some such cross, but it is of interest to come across a wild example of a variety that was first noticed in breeding experiments. The fawn colour is to be explained by the absence of the normal black pigment in the colouration.

RATTUS NORVEGICUS (Erxl.) Brown Rat

The Brown Rat is much too common all over the district. Though he has handled thousands in the course of his work, Mr. C. Ryman has only come across one variety, i.e., a buff-coloured one caught a few years ago. No specimens have been seen of the black variety, the so-called *Mus hibernicus*.

Trapping and other means are now extensively used to try to keep down the numbers of rats. The following figures of Brown Rats caught and recovered in one infested area where regular trapping is carried out may be of some interest. At one time it was possible to catch as many as 300 in one night, but trapping has undoubtedly reduced this number considerably; in 1930 those recovered numbered 1,004, but these numbers have been lessened by degrees down to 826 in 1934. It does, however, show the difficulty of getting rid of rats once they have formed a large colony.

The measurements of a male and female in the collections are given for comparison with the Black Rat:—

Male	HB 225	Tail 160	HF 44	Ear 19 mm.
Female	„ 260	„ 180	„ 38	„ 18 „

ARVICOLA AMPHIBIUS AMPHIBIUS (Linn.) Water Vole

The Water Vole, also commonly called the Water Rat, is easily distinguished from the Field and Bank Voles by its large size, thick furry coat and long tail.

It is common in the Bristol district, both on the Somerset and Gloucestershire sides.

Up to the present I have no information as to the black variety which is said to occur. In *Zoologist*, 1892, p. 287, Mr. H. W. Marsden reports it as absent in Gloucestershire, and the Rev. M. A. Mathew (Macpherson and Aplin *loc. cit.*, p. 292) writes that “I have seen them in several places in this county . . . at Wrington in East Somerset.” According to *Brit. Ass. Handbook to Bristol neighbourhood*, 1898, p. 201, “A black variety occurs in the Avon.” Mr. Whish finds the Water

Vole common in the Lympsham district but has not come across any black variety. The head keeper at Tortworth Court informed me that black varieties were to be found round the lake there. An immature albino male from Brent Knoll, June 12, 1937, is in the collections.

As mentioned in the Preface, Water Voles are preyed on largely by Herons. In an examination of 26 pellets from a local heronry their remains were found in 85%.

The following measurements of a male and female in the collections will give an idea of their size :—

Male	HB 190	Tail 115	HF 32	Ear 18 mm.
Female	„ 180	„ 140	„ 35	„ 15 „

[ONDATRA ZIBETHICA (Linn.) Musk Rat]

In view of the fact that one of the principal infestations of this North American rodent has been in the Severn, in the vicinity of Shrewsbury, with an obvious possibility that the animals may escape and follow the course of the river, the Musk Rat is included, though up to the present none have been recorded from the Bristol district. There are, however, three isolated records from only just outside this area. These are as follows :—

- (1) Saul Lodge, Frampton-on-Severn. One killed in a ditch half a mile from the Severn, June 30, 1931.
- (2) Sharpness. Dead body of one found in a lock, July, 1933.
- (3) Beachley. Male killed on the beach, April 23, 1934.

(T. Warwick, *Journal Animal Ecology*, III, p. 253, 1935.)

It is not a native of this country, but has been introduced from North America to be bred in “ farms ” for the sake of its fur, which is known as Musquash. So serious, however, have been its depredations in Central Europe, where three females and two males introduced in 1905 had grown to an estimated population of 100,000,000 in 1927, and have caused a great deal of damage by tunnelling into river and canal banks, that steps were taken in Britain, firstly, to licence all Musk Rat farms, and finally to prohibit their importation alive altogether under the Destructive Imported Animals Act, 1932. In addition, special trappers were employed to catch as many animals as possible in the chief centres of infestation. But in spite of all these precautions, it is just possible that some may have escaped and may found colonies elsewhere.

The Musk Rat is like a giant Water Vole, with the same thick fur, but in addition to the difference in size, it has a long scaly tail and

hind-feet very large and much larger than the front feet. The sides of the hind-feet and of each of the five toes have a fringe of stiff whitish hairs for use when swimming. It infests streams, canals, marshy ground, etc., and as it is largely nocturnal it may be present in a locality for some time before it is seen, especially as the entrances to the burrows are usually placed under water. The burrows may be very long, often more than 100 feet, and it is by the collapse of these that great damage may be caused when a river or canal bank is tunnelled into. In the autumn, large mounds or "lodges" are formed which, though primarily stores of food for winter, also serve as dwelling places during hard frost.

The following measurements give an idea of its size. Its weight is about 2 lbs. :—

HB 309 Tail 254 HF 76 mm.

MICROTUS AGRESTIS HIRTUS (Bellamy) Field Vole

The Field Vole can be distinguished from the Bank Vole by the fact that its tail is distinctly less than half the length of head and body combined, and by certain details in the palate of its skull. It is also in this district much greyer on the average.

It is probably common throughout the area, both in Somerset and Gloucestershire. Specimens have been obtained in the former from Abbots Leigh, Portishead, Charterhouse-on-Mendip and Lympsham, and in the latter from Little Stoke and Avonmouth Docks. It is a difficult animal to trap but a useful corrective to trapping is to examine the pellets, or castings, of Owls. As stated in the Preface, this gave, in the case of those from a Barn Owl at Little Stoke, a figure of 70% for the Field Vole out of 166 skulls examined. Trapping in the same neighbourhood only produced one caught in 49 traps set, a striking difference.

The measurements of the largest specimens in the collections are as follows :—

Male.	Portishead.	15.VII. 1933.	HB 115	Tail 30	HF 15	Ear 10 mm.
"	Little Stoke.	26.VII. 1933.	" 105	" 32	" 15	" 11 "
"	" "	25.III. 1933.	" 98	" 27	" 15	" 10 "
"	Portishead.	15.VII. 1933.	" 95	" 30	" 15	" 10 "
Female.	Abbots Leigh.	24.VIII.1933.	" 98	" 28	" 15	" 12 "
"	Nailsea.	12.X. 1933.	" 88	" 30	" 14	" — "

The average for 8 males was 95.7 mm. and for 4 females 89.5 mm. Specimens over 100 mm., according to Barrett-Hamilton (Vol. II, p.446), are rare and probably represent "the size regularly reached by really

old animals." The two largest specimens in the collections were both obtained in July.

The only variation in colour is that of an albino male found in a garden at Tickenham, Somerset, on May 26, 1932.

It is well-known that Field Voles occur in swarms in certain years, a feature that is probably cyclic. The swarms seen on the mud off Berrow, Somerset, by Mr. Whish in 1926 (see Bank Vole) no doubt contained large numbers of these animals, while the fact that five were caught in November, 1933, in the unusual surroundings of a timber yard at Avonmouth Docks, might indicate an overflow from a surplus population close by.

Short-eared Owls (*Asio. f. flammeus*) prey very largely on Field Voles, and their presence in any locality can be attributed to an increase in these animals. It is therefore of interest to record that during the winter of 1934-1935 three of these birds arrived on the flats immediately north of Avonmouth and stayed several months. From an examination of a few pellets, they were feeding on the voles which were certainly numerous, though not in sufficient numbers to constitute a plague. None of these Owls had been seen in this area in recent years.

In addition to the damage that can be caused by eating the base of grass-stalks, these Voles may also be a nuisance to the forester, and damage caused to seedling trees by having the bark eaten off them is almost certainly to be attributed to Field Voles.

EVOTOMYS GLAREOLUS BRITANNICUS (Miller) Bank Vole

The tail of the Bank Vole is about half the length of the head and body combined, a feature that will distinguish it from the Field Vole; it is also, on the average, much redder, at least in this area.

The description "hardly uncommon, but local" given in Rudge and Charbonnier, p. 60, does not apply at the present day. There are specimens in the collections from Brean Down, Portishead, Nailsea, Abbots Leigh and Lympham in Somerset, and from Little Stoke, Hallen Marsh and Dyrham in Gloucestershire. It has been caught wherever trapping has been carried out and may be described as "very common throughout the area."

The measurements of the largest specimens in the collections are as follows:—

Male.	Portishead.	14.V. 1933.	HB 102	Tail 45	HF 15	Ear 10 mm.
"	"	16.IV. 1933.	" 100	" 38	" 15	" 10 "
"	"	30.IV. 1933.	" 100	" 38	" 15	" 10 "
Female.	Nailsea Moor.	21.VIII.1933.	" 102	" 43	" 16	" 14 "
"	Abbots Leigh.	24.VIII.1933.	" 98	" 47	" 15	" 10 "

An average for ten males gives an HB length of 94.8 mm. and for seven females 89.6 mm., so that those given above are considerably over the average.

The only variety noted is one (male, Lympsham, May 6, 1932) which has white hairs on the top and side of the crown.

In some cases, at least, these Voles occur in swarms. Mr. H. J. Charbonnier (1898, p. 200) saw, in 1888, small scattered parties of eight or ten making their way steadily in one direction down the valleys of Leigh Woods, where they were very abundant that year, and suggests they were in search of water. Mr. Whish also informs me that in October, 1926, there was a great plague of Voles on the shore near Berrow, Somerset. It lasted for six or eight weeks, and the mud was covered with tracks suggesting that the Voles were moving about in columns about two to two and a-half inches wide. The Voles he saw, not many, were Bank Voles, but there were also Field Voles and Field Mice as well as many Short-eared Owls preying on them all.

VI. CARNIVORA

MUSTELA N. NIVALIS Linn. Weasel

The Weasel may be distinguished from the Stoat by its smaller size, and the lack of a tuft of black hairs at the end of its tail. The line of demarcation between the brown of the upper and the white of the lower surface is irregular, and not straight as in the Stoat.

It is common throughout the district, both in Somerset and Gloucestershire.

The following are the measurements of two skins in the collections:—

Male.	Little Stoke.	29.XII.1933.	HB 215	Tail 53	HF 32	Ear 16 mm.
„	Avonmouth Dks.	14.X. 1932.	„ 200	„ 45	„ 28	„ 12 „

The second of these was caught accidentally in a rat-trap at the Docks.

Weasels only very exceptionally turn white in this district. A white one was reported on good authority to have been seen in Ashton Park in January, 1933, but was not secured.

MUSTELA ERMINEA STABILIS (Barr.-Ham.) Stoat

The Stoat is widely distributed and common in all parts of the district. It is larger than the Weasel, has a long tail with a long black tip, and the colours of the upper and under parts are distinctly separated by a straight and not irregular line.

In the summer, Stoats may go about in "packs," no doubt two or more litters having joined together. These have been observed in Leigh Woods and on Cadbury Camp. In the former, about a dozen were seen by Mr. H. C. Baker hunting and working every bit of ground very thoroughly, and on another occasion his son, C. Baker, was fortunate enough to see about fifteen playing together in a hollow.

The very puzzling question of some Stoats turning white in winter is clearly met with in this district. This was noted by Rudge and Charbonnier (p. 58) as occurring "after exceptionally mild weather," and the authors supposed that those that turned white were migrants from further north, a supposition which, as far as is known, has no real foundation. But, as will be seen later, the remark about mild weather is strongly supported.

Specimens of white or partially white Stoats in the collections are as follows:—

<i>Sex.</i>	<i>Locality.</i>	<i>Date.</i>	<i>Measurement.</i>	<i>Remarks.</i>
Male.	Stoke Gifford.	30.I.1934.	HB 295 mm.	Upper surface of all feet largely white.
Female.	Cocklake, Som.	30.I.1934.	„ 250 „	Nearly completely white, some brown on head, and yellowish tinge on white of tail and continuing on to the back.
„	„ „	14.II.1935.	„ 260 „	as last.
„	„ „	14.II.1936.	„ 258 „	as last two. This was too stale for preservation.
Male.	Burtle, Som.	17.II.1932.	„ 290 „ (from skin)	Upper part and sides of head and top of shoulders brown; brown mixed with white down the back. Clear brown at root of tail. Remainder white.
Female.	Abbots Leigh.	23.II.1934.	„ 249 „	In full moult from a probable white winter coat. A very interesting stage.
?	Pensford, Som.	14.II.1928.	„ ? „	Colour about the same as the male from Burtle.

In addition, Mr. H. H. Davis informs me that a white Stoat was shot near Filton station in the winter of 1932-1933. From reliable sources I have heard that, in Somerset, many Stoats turn white in the neighbourhood of Abbots Leigh, whereas in the Wraxall district the keepers do not notice any difference of colour in summer and winter, these two places being only about $3\frac{1}{2}$ miles apart. Mr. F. H. L. Whish informs me that in the Lymphsham district white Stoats are very uncommon, but that one nearly white was killed at Kewstoke on January 22,

1936. Mr. Stanley Lewis, of Cheddar, is of the opinion that more white Stoats occur in mild winters.

As regards the last point, it is of particular interest that all the specimens, with the possible exception of one (Nov. 14, 1936), occurred in mild winters, and it will be noticed that, of the five most markedly white, three are females and one is a male, the sex of the other being unrecorded. Another point of interest is that on January 14, 1935, a male was also taken at Cocklake, but this was of the normal colour and not white as was the female in the following month from the same place. As the winters of 1933-1934 and 1934-1935 were particularly mild, this will strongly support the idea that the change is not caused by climate, and also, to a more limited extent, will confirm the observations of Mr. Hudson, quoted by Millais, 1905, p. 108, that, in the south of England, the change to white is much more prevalent in the females than in the males.

Of those in the collections, one taken on Brean Down in January, 1923, is a bright chestnut-brown above and bright yellow beneath, and the male from Cocklake mentioned above is also markedly yellow beneath.

The following measurements of specimens in the collections show that some very large Stoats occur in this area:—

Male.	Stoke Gifford.	30.I.1934.	HB 295	Tail 90	HF 50	Ear 28 mm.
„	Wraxall.	15.III.1934.	„ 282	„ 116	„ 49	„ 26 „
„	Bristol.	10.VIII.1934.	„ 300	„ 110	„ 47	„ 22 „

PUTORIUS P. ANGLIUS Pocock Polecat

The Polecat is very rare but may possibly still be found in the higher and less-frequented parts of the district. It may be distinguished from the Stoat by its larger size, brown and white markings on the head and long bushy tail.

In order to give full details of its occurrence, as far as is known to me, I am combining all information available.

Gloucestershire

1872. One, Coalpit Heath (Rudge and Charbonnier, 1909, p. 58).

1898. "Still, or was till lately, occasionally found near Nailsworth." (*Brit. Ass. Handbook to Bristol Neighbourhood*, 1898, p. 201).

1933. The late Engineer Captain H. H. Wilmore, R.N., informed me that about September he saw on the Cotswolds about

five miles from Wotton-under-Edge an animal which appeared bigger than a Stoat and had a bushy tail. He had a quick glimpse of it at about fifty yards range as it turned off into a rickyard. This was almost certainly a Polecat.

Somerset

- 1833-1835. One, mounted by J. S. Counter, Wells, between the years named, and probably local, is now in Wells Museum.
1870. One killed on Tor Hill, Wells, about this date, and now in Wells Museum.
1885. One trapped in Hollowmarsh, near Farrington Gurney, by keeper Brown, Chewton Mendip, about this date (Tucker, p. 100).
1912. One shot, Greendown, Harptrees, Mendips, about this date after killing 24 fowls (Tucker, pp. 100, 101).
1916. A possible Polecat was seen in the shrubbery of Chewton House, Chewton Mendip, by Mr. B. W. Tucker in July (Tucker, p. 101).
1919. A possible Polecat was seen by Lord Waldegrave on August 11 by Eaker Hill Wood, Mendips (Tucker, p. 101).
1928. About this date one was killed in the Cheddar Gorge (F. H. L. Whish).
1934. About this date and possibly in the following years two are said to have been seen on the Mendips in the neighbourhood of Axbridge (S. Lewis).

In addition to these more definite records, Rudge and Charbonnier state that a few others turned up at long intervals between 1880 and 1909 but without giving particulars of such occurrences.

It must, however, be pointed out that some of the above records may refer to Polecat-Ferrets. These have all the typical markings of the Polecat, and though in some cases these ferrets are very much smaller, in others they are just as large as the wild animal and could be distinguished from them only with difficulty even if they were handled.

One Ferret, for example, a male killed near Pensford, Somerset, April 5, 1937, though it had the characteristic yellowish-white colour of the Ferret, was as large as a big male Polecat. It weighed $3\frac{1}{4}$ lbs. and measured HB 463, Tail 138, HF 60, Ear 29 mm., but the carnassial teeth were much smaller than those of a male Polecat, with which it was compared, in spite of its much greater size.

MARTES M. MARTES (Linn.) Pine Marten

There is, unfortunately, no doubt that this fine animal is quite extinct in the Bristol district.

One hundred years ago (*Journal of a Naturalist*, 1829, p. 139) the author, J. L. Knapp, who lived at Thornbury, seven miles north of Bristol, wrote that the "Marten lingers with us still, and every winter's snow becomes instrumental in its capture, betraying its footsteps to those who are acquainted with the peculiar traces it leaves."

"One was caught at Berkeley about sixteen years ago" (*Brit. Ass. Handbook to Bristol Neighbourhood*, 1898, p. 201) and this is no doubt the one referred to by Witchell and Strugnell (1892, p. 23), "Ten years ago Mr. Scott-Hayward kept one in captivity; it had been caught at Berkeley; and it displayed marvellous activity in darting about its large room or aviary, but was untamable."

There are no more recent records.

VULPES V. CRUCIGERA (Bechst.) Fox

The Fox is common throughout the district, possibly commoner on the Gloucestershire side where it is preserved more strictly than in Somerset where, except for the Mendip area, no hunting is carried on. It is, however, plentiful even where not preserved and occurs close to Bristol. On one occasion a Fox got into the Clifton Zoological Gardens and killed a Barnacle Goose there.

Foxes vary very much in colour, and the skin of one from Brean, Somerset, may be mentioned. This is remarkable in being of a bright sandy-rufous colour, and white beneath. Though the area of sand dunes in this district is not large, it is interesting to note that mammals from here are brighter and more sandy than those found further inland, and examples may be given in Stoats, Rabbits and Field Mice, in addition to this Fox.

MELES M. MELES (Linn.) Badger

Evidently a great change in its favour has come over the Badger since the last two reports. Described in *Brit. Ass. Handbook to Bristol Neighbourhood*, 1898, p. 202, "The Badger which used to be common is still a member of the fauna in our district," and by Rudge and Charbonnier, 1909, p. 58, "Maintains its numbers in a few places, but it has disappeared from many of its old haunts," the Badger can now be said to be widespread and locally common in both parts of the Bristol

district. It is to be found in many places on the higher ground, from about 200 feet upwards, where conditions are suitable to it.

To a great extent it is nocturnal and thus may not be seen very often in spite of its striking colouration. Occasionally it comes out in daylight, as for example when one was seen at Barrow Gurney by K. B. Rooke at 3.0 p.m. on February 17, 1934. The earths, or setts, may be structures of considerable size, underground galleries where a number of these animals live. In spring and autumn a cleaning of the burrows takes place, and large heaps of earth and dried grass may be found outside them. The food is very varied, and undoubtedly Badgers do a great deal of good by keeping down the number of Rabbits. They have a great faculty for digging straight down into a nest of young Rabbits, discovering them by scent through the earth above, and killing the occupants. At times they are a nuisance owing to the damage they can do to nesting birds and eggs. Two were evicted from the well-known bird sanctuary of Brean Down for that very reason, after being there for four or five years. A female, which was said to have caught over 20 fowls, was shot at Oldbury Court, Fishponds, Bristol, on April 13, 1933. Another, also a female, was trapped and shot near Abbots Leigh on August 12, 1933, owing to the damage it had done to fowls and their eggs.

The heaviest Badger of which I have any record is a male of 28 lbs. from Cheddar, February 16, 1931. Other weights are female, Fishponds (see above) 20 lbs. and the female from Abbots Leigh (see above) 12 to 14 lbs. calculated weight.

The following measurements are taken from specimens in the collections :—

Male	..	HB 765	Tail 160	HF 110	Ear 50 mm.
"	..	" 675	" 170	" 111	" 40 "
Female	..	" 700	" 160	" 100	" 43 "
"	..	" 690	" 165	" 95	" 46 "

LUTRA LUTRA (Linn.) Otter

The Otter is sparingly distributed throughout the district, mainly, of course, along the rivers and streams. North of Bristol it is found in the Frome and in the neighbourhood of Tortworth Court, while in Somerset its distribution is chiefly along the upper reaches of the Avon, and in the region of the rivers Kenn, Yeo and Axe.

The skin of a female from Keynsham, taken about February 8, 1911, is in the collections, as is that of a male from Falfield, Glos.,

July 19, 1938. The following are the measurements of this Otter:—

Male. HB 737 Tail 417 HF 120 Ear 25 mm. Weight 14½ lbs.

A curiously spotted variety, dappled like a Fallow Deer, was killed on the Axe, below Cheddar, on February 5, 1935 (Stanley Lewis, *Field*, March 2, 1935).

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Studies on the Biology of the Bristol Channel

IV

THE INVERTEBRATE FAUNA OF THE SOUTHERN SHORES OF THE BRISTOL CHANNEL AND SEVERN ESTUARY

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(*Read in title, March 1, 1941*)

AN introduction to this series of studies has been written by Professor C. M. Yonge (1937). The present contribution aims at giving a complete list of marine invertebrates previously recorded from the Devon, Somerset and Gloucestershire coasts from Ilfracombe to above Gloucester, supplemented by records made during 1939 and 1940. The majority of the older records are of hydroids, polyzoa, crustacea and a few sponges from Ilfracombe (Gosse, 1853; Hincks, 1868 and 1880; Norman and Scott, 1906; Bowerbank, 1864). An important contribution was, however, made by Swanton (1912) who listed the molluscs of the Somerset coast. His list includes records up to the mouth of the Avon. More recently Matthews (1923, 1932) has contributed to our knowledge of the region about Weston and Portishead, and additional records for Weston are available from Ebling (1940). In two valuable papers, Purchon (1937) and Rees (1939) have provided, the former an exhaustive list of the fauna of the beach and dock at Portishead and the latter an account of the animals taken in the plankton of the Cardiff Roads. All these data and occasional records from other sources are included in the present fauna list, where appropriate acknowledgement is made.

Records having no acknowledgement are new and have been made during the present survey.* Animals have been collected during 1939 and 1940 at 14 selected stations from above Gloucester to Blue Anchor Bay. Physical data have also been collected, and a complete account of the collecting stations and the physical data together with a discussion of the results will be presented elsewhere.

* But see special notes under Ostracoda and Copepoda.

In a survey of this nature much assistance is invariably claimed from colleagues and specialists. The present survey is no exception and I am pleased to acknowledge my indebtedness to the under-mentioned zoologists.

Dr. R. D. Purchon assisted in the collection and identification of specimens during the spring of 1939. It is his fauna list for Portishead which is incorporated in the present list. Mr. A. J. Lloyd has assisted on many collecting expeditions throughout the survey, he determined some of the earlier salinity samples, identified all prawns and the rarer crabs and finally has supplied records of invertebrates taken in the nets and kypes in the estuary. All such records, where not otherwise acknowledged, are from this source. All fishes taken on the shore were identified by Mr. Lloyd and are not listed here but have been included in an accompanying paper (Lloyd, 1941a.). Dr. L. H. Matthews has provided transport on several important occasions, and Mr. F. J. Ebling has assisted on a few collecting expeditions as well as contributing records for Weston. Finally, Mr. G. G. Vickers has assisted on a few occasions and has made occasional identifications.

Notable among the specialists who have made invaluable contributions to the work of the survey are Mr. G. M. Spooner and Dr. A. B. Hastings. Mr. Spooner identified the earlier collections of species of *Gammarus* and then suggested that certain additional collections should be made. He subsequently identified most of the amphipods taken in these collections, and the extent of his labours can best be determined by an examination of the amphipod section of this list. He also determined some of the collections of *Sphaeroma* species. Dr. Hastings identified the relatively few polyzoa taken in the earlier surveys, but then undertook the considerable task of bringing up to date the names of the many species previously recorded from the Ilfracombe region. Professor W. M. Tattersall has identified the mysids and Dr. H. Gorvett certain isopods. Occasional species have been collected or identified by various workers, and these are acknowledged in the appropriate places. Mr. D. P. Wilson and Mr. W. J. Rees kindly offered to check the identifications of polychaetes and hydroids respectively, but the specimens were lost in transit and their offers could not be accepted. Except for the gap occasioned by the loss of these specimens, a complete collection has been made of all species taken by Dr. Purchon at Portishead and during this survey.

The expenses of the survey and of the publication of this paper

have been borne by the Colston Research Fund of the University of Bristol and by the Leverhulme Trustees, and the survey has at all times been subject to the general supervision of Professor C. M. Yonge.

FAUNA LIST

The names of species and the authorities used in their identification are those given in the *Plymouth Marine Fauna* 1931, 2nd Edition, except where otherwise stated.

Phylum PROTOZOA

MASTIGOPHORA

Order Dinoflagellata

.NOCTILUCA SCINTILLANS Macartney

Ilfracombe, 1852 (Gosse, 1853, p. 253 as *N. miliaris*).

RHIZOPODA

Order Foraminifera

GROMIA OVIFORMIS Dujardin

Blue Anchor (East), 23.4.1940, common on rough rock at L.W.S.T. and in debris up to M.T.L. (identified by D. L. Mackinnon).

Other Foraminifera

In plankton of Cardiff Roads, November and December, 1936, present; September, 1936, common (Rees, 1939): Blue Anchor Bay, 23.4.1940, shells occur among debris.

CILIOPHORA

Sub-Class SUCTORIA

OPHRYODENDRON TRINACRIUM Grüber

In plankton of Cardiff Roads, 1936-7, on the copepod *Tisbe* (= *Idya*) *furcata* (Rees, 1939).

Phylum PORIFERA

CALCAREA

LEUCOSOLENIA BOTRYOIDES (Ellis and Solander)

Hele, near Ilfracombe, 21.6.1852 (Gosse, 1853, p. 234 as *Grantia*).

SYCON CORONATUM (Ellis and Solander)

Hele, near Ilfracombe, 21.6.1852 (Gosse, 1853, p. 238 as *Grantia ciliata*).

DEMOSPONGIARIA

Sub-Class MONAXINELLIDA

HALICHONDRIA PANICEA (Pallas)

Lee Bay, Ilfracombe, 1852, on walls of a cave (Gosse, 1853, p. 276).

HALICHONDRIA COALITA (Grant)

Devon (Bowerbank, 1866, II, p. 239).

HYMENIACIDON SANGUINEA (Grant)

Lee Bay, Ilfracombe, 1852, on walls of a cave (Gosse, 1853, p. 276 as *Halichondria*).

HYMENIACIDON PERLEVIS (Montagu)

Devon (Bowerbank, 1866, II, p. 178).

RASPAILIA HISPIDA (Montagu)

Devon (Bowerbank, 1866, II, p. 108).

RENIERA INDEFINATA (Bowerbank)

Ilfracombe (Bowerbank, 1866, II, p. 286 as *Isodictya*).

ESPERELLA LOBATA (Montagu)

Coast of Devonshire (Bowerbank, 1866, II, p. 326 as *Isodictya*).

PACHYCHALINA MONTAGUI (Montagu)

Devonshire coast (Bowerbank, 1866, II, p. 366 as *Chalina*).

There are *small sponge colonies* at Kilve and Blue Anchor but these are as yet unidentified.

Phylum COELENTERATA

HYDROZOA

Order Hydroida

Sub-Order *Athecata*

CLAVA MULTICORNIS (Forskål)

Aust, 19.3.1939, in the gully; 16.8.1939, on *Tubularia indivisa* at L.W.M.: Blue Anchor (East), 23.4.1940 at M.T.L.: breeding March and April: Ilfracombe (Gosse, 1853, p. 206).

PODOCORYNE PROBOSCIDEA Hincks

Ilfracombe (Hincks, 1868).

TURRIS NEGLECTA Lesson

Blue Anchor (East), 23.4.1940, common on the dead shells of *Pholas* in burrows in the rock. The hydroid is also recorded by Hincks 1868, p. 15) and the medusa by Gosse (1853, p. 348) from Ilfracombe.

PERIGONIMUS REPENS (T. S. Wright)

Ilfracombe on stone (Hincks, 1868).

PERIGONIMUS SERPENS Allman

Ilfracombe, on rocks and *Laminaria* (Hincks, 1868, p. 96).

LAR SABELLARUM Gosse

Ilfracombe, the medusa *Willia stellata* only (Gosse, 1853, p. 359).

EUDENDRIUM INSIGNE Hincks

Ilfracombe (Hincks, 1868).

EUDENDRIUM RAMOSUM (L.)

Generally distributed (Hincks, 1868, p. 83).

CORYNE MUSCOIDES (L.)

Ilfracombe, fairly common in tide pools (Hincks, 1868, p. 41 as *Coryne vaginata*).

CORYNE PUSILLA Gaertner

Ilfracombe, in rock pool (Hincks, 1868, p. 40).

CORYNE SESSILIS Gosse

Ilfracombe (a new species) (Gosse, 1853, p. 208). Allman (1871, p. 271) regards it as a provisional species, and Hincks (1868, p. 40) suggests that it may be the young of *C. pusilla*.

CORYNE RAMOSA Sars

Ilfracombe, on *Ptilota sericea* in a rock pool below the Torrs (Gosse, 1853, p. 190). This is a doubtful species allied to *C. pusilla* (Allman, 1871, p. 270).

SYNCORYNE PULCHELLA Allman

Ilfracombe (Hincks, 1868, p. 319).

CLADONEMA RADIATUM Dujardin

Ilfracombe (Gosse, 1853, p. 257 as *Coryne stauridea*).

ACHARADRIA LARYNX Wright

Ilfracombe (Hincks, 1868, p. 134).

STAUROIDIUM PRODUCTUM Wright

Ilfracombe, very common (Hincks, 1868, p. 68). Hincks also points out that the *Coryne cerberus* of Gosse (1853, p. 222) is the young of this species.

CLAVATELLA PROLIFERA Hincks

Ilfracombe (Hincks, 1868, p. 75).

MYRIOTHELA COCKSI (Vigurs)

Ilfracombe (Hincks, 1868, p. 77 as *M. phrygia*).

TUBULARIA INDIVISA L.

Common at L.W.S.T. from Blue Anchor to Portishead : abundant at Weston—breeding in April and not breeding in August : abundant but dwarfed at Aust where all were dead on 9.3.1940 : previously recorded from Portishead by Purchon (1937) and from Portishead and Weston by Matthews (1923) : not definitely recorded from Ilfracombe by Hincks (1868) or Gosse (1853) although it is a common marine and estuarine species.

Sub-Order *Thecata***HALECIUM BEANI (Johnston)**

Common and widely distributed, dredged (Hincks, 1868, p. 255).

HALECIUM HALECINUM (L.)

Kilve, 21.5.1939, small colonies at L.W.S.T. (identified by W. J. Rees) : very common and generally distributed, dredged (Hincks, 1868, p. 222).

HYDRANTHEA MARGARICA (Hincks)

Ilfracombe, very common on *Flustra foliacea* only, 7 to 10 fathoms (Hincks, 1868, p. 101).

CAMPANULARIA VOLUBILIS (L.)

Smallmouth (hydroid, embryo and medusa) and Santon (Gosse, 1853, p. 296 and p. 434) : widely distributed (Hincks, 1868, p. 161).

CAMPANULARIA INTEGRAL Macgillivray

On red weed at Ilfracombe (Hincks, 1868, p. 164).

CAMPANULARIA EXIGUA Sars

At Kilve, 21.5.1939, under stones on reef at L.W.M. ; 18.8.1939, on *Tubularia indivisa* from L.W.M. on reef. A doubtful species (W. J. Rees *in lit.*).

CAMPANULARIA DIVISA

Ilfracombe (Todd, 1906). This species has not yet been traced.

ORTHOPYXIS CALICULATA (Hincks)

Ilfracombe (Hincks, 1868, p. 164).

CLYTIA JOHNSTONI (Alder)

Kilve, 18.8.1939 and Weston, 17.8.1939, on *Tubularia indivisa* from L.W.S.T. : the medusa, *Phialidium hemisphaericum*, was recorded from Ilfracombe by Gosse (1853) and Ilfracombe is probably included in the record of the hydroid in Hincks (1868, p. 145—"Extremely common").

OBELIA DICHOTOMA (L.)

Common (Hincks, 1868, p. 157): Purchon (1937) recorded this species from Portishead at L.W.M.

OBELIA GENICULATA (L.)

"Common at low tide on Battery Point, Portishead" (Matthews, 1923): Ilfracombe (Gosse, 1853, pp. 331 and 434 as *Laomedia*): very common and generally distributed on seaweed (Hincks, 1868, p. 151).

GONOTHYREA LOVENI (Allman)

On mooring ropes in Portishead Dock (Purchon, 1936).

LAOMEDIA GELATINOSA (Pallas)

Birnbeck Island, Weston, 19.4.1939, abundant and widespread in pools on shingle and rocks, and in gullies at L.W.N.T., breeding: Blue Anchor (East), 23.4.1940, common on stones among mud: Aust, 16.8.1939, on weed in the gully (identification checked by Capt. Totton): Stolford, 20.6.1939, present: Gosse (1853) and Hincks (see Todd, 1906) record it from Ilfracombe.

LAOMEDIA FLEXUOSA Hincks

Extremely common on all parts of our coast (Hincks, 1868, p. 170).

ZYGODACTYLA VITRINA (Gosse)

The gonosome, Ilfracombe (Gosse, 1853, p. 340 as *Aequorea*).

OPERCULARELLA LACERTA (Johnston)

Ilfracombe (Hincks, 1868, p. 195).

CALYCELLA SYRINGA (L.)

Very common (Hincks, 1868, p. 207).

LAFOEA DUMOSA (Fleming)

Common and generally distributed, 15-35 fathoms (Hincks, 1868, p. 201).

LAFOEA DUMOSA The gonosome COPPINEA ARCTA Dalyell

Common and generally distributed especially on *Lafoea dumosa*, *Sertularia abietina* (now *Abietinaria abietina*) and on *Hydrallmania falcata* (Hincks, 1868, p. 220).

OPHIOIDES MIRABILIS Hincks

Very abundant on *Laminaria* (Hincks, 1868, p. 233).

DIPHASIA ATTENUATA (Hincks)

Ilfracombe (Hincks, 1868, p. 249).

DIPHASIA ROSACEA (L.)

Wildersmouth Beach near Ilfracombe, dead (Gosse, 1853, p. 434 as *Sertularia*): generally distributed (Hincks, 1868, p. 246).

DYNAMENA PUMILA L.

Kilve, 18.8.1939, rare, L.W.M.; 10.3.1940, rare, alive but not breeding: Portishead, 1936, rare (Purchon, 1937): Smallmouth in Combe Martin Bay on *Corallina officinalis* (Gosse, 1853, p. 434): generally distributed and common on rocks and *Fucus* (Todd, 1906): "This zoophyte is met with on the most barren shores" (Hincks, 1868, p. 261).

SERTULARELLA FUSIFORMIS (Hincks)

Ilfracombe (Hincks, 1868, p. 243).

SERTULARELLA GAYI (Lamouroux)

Generally distributed (Todd, 1906 as *Sertularia*).

ABIETINARIA ABIETINA (L.)

Portishead, dead specimens stranded on Royal Beach (Purchon, 1937): on oysters from Lee, Ilfracombe (Gosse, 1853, p. 434 as *Sertularia*): generally distributed and common, sometimes in great abundance inside the 30 fathom line (Todd, 1906).

HYDRALLMANIA FALCATA (L.)

Dead colonies stranded all over the estuary (1939): universally distributed (Hincks, 1868, p. 275).

SERTULARIA CUPRESSINA (L.)

Common from Kilve to Aust (excluding Weston where it was absent); at Aust the colonies are regularly spaced over a wide area of muddy rock at L.W.M.; reproductive bodies were noted in May, 1939: not recorded from Blue Anchor, 22.4.1940: common in trawl refuse and fairly common in estuaries (Todd, 1906): the colonies and hydrothecae conform to the type described as *S. argentea* (Hincks, 1868, p. 268)—a species which is now included in *S. cupressina* (*Plymouth Marine Fauna* 1931, p. 76 and W. J. Rees *in lit.*).

SERTULARIA OPERCULATA L.

Portishead, 1936, stranded on Royal Beach (Purchon, 1937): generally distributed (Hincks, 1868, p. 264).

SERTULARIA GRACILIS Hassall

Ilfracombe (Hincks, 1868, p. 263).

KIRCHENPAUERIA PINNATA (L.)

Common and generally distributed, L.W. to 30 fathoms (Hincks,

1868, p. 295 as *Plumularia*): Ilfracombe, Baggy Point and Smallmouth (Gosse, 1853, pp. 287 and 434 as *Plumularia*).

ANTENNELLA SECUNDARIA (Gmelin)

Ilfracombe (Hincks, 1868 as *Plumularia catharina* "stemless variety").

MONOTHECA OBLIQUA (Johnston)

Ilfracombe, abundant (Hincks, 1868, p. 304 as *Plumularia*).

PLUMULARIA SETACEA (Ellis & Solander)

Hele, 14.8.1852, on *Plumularia cristata* (= *Aglaeophenia pluma*), on a crab, reproducing; also Tunnel Rocks and Santon Rocks—all near Ilfracombe (Gosse, 1853, p. 143 and p. 434): common, L.W. to 30 fathoms (Todd, 1906).

PLUMULARIA HALECIOIDES Alder

Ilfracombe, in rock pools (Hincks, 1868, p. 307).

PLUMULARIA CATHARINA Johnston

Common 15 to 30 fathoms on fine sand, fairly common inshore (Todd, 1906).

NEMERTESIA ANTENNINA (L.)

Hele near Ilfracombe, 14.8.1852, on a crab, reproducing (Gosse, 1853, p. 311): common 15 to 30 fathoms, medium gravel and muddy sand (Todd, 1906). As *Antennularia*.

THECOCARPUS MYRIOPHYLLUM (L.)

Moderately common, 15 to 30 fathoms (Todd, 1906 as *Aglaeophenia*).

AGLAEOPHENIA PLUMA (L.)

Common and generally distributed in *Laminaria* zone on algae, especially *Halidrys siliquosa* (Hincks, 1868, p. 286): Ilfracombe, 14.8.1852, reproducing (Gosse, 1853, p. 143 and p. 434 as *Plumularia cristata*).

HYDROZOA

Order Hydromedusae

Sub-Order Anthomedusae

AMPHINEMA DINEMA (Peron et Leseur)

Capstone Hill, Ilfracombe, 29.8.1852, in pools (Gosse, 1853, p. 387 as *Saphenia titania*).

TURRIS NEGLECTA Lesson

Medusa obtained from hydroid at Ilfracombe, Autumn, 1852 (Gosse, 1853, p. 348).

WILLIA STELLATA (Forbes)

Ilfracombe, 8.9.1852 (Gosse, 1853, p. 359).

OCEANIA PUSILLA Gosse

Ilfracombe (Gosse, 1853, p. 384). Haeckel (1879, p. 654) suggests that this is the young of *Tiara* or *Turris* although Gosse was familiar with at least one young *Turris* (see above).

Sub-Order *Leptomedusae*

COSMETIRA PILOSELLA (Forbes)

Common at Ilfracombe (Gosse, 1853, p. 334 as *Thaumantias*).

GOSSEA CORYNETES L. Agassiz

Ilfracombe (Gosse, 1853, p. 407 as *Thaumantias*).

PHIALIDIUM HEMISPHERICUM (L.)

Ilfracombe (Gosse, 1853, p. 386 as *Thaumantias buskiana*).

AEQUOREA FORSKALEA Peron et Lesueur

Ilfracombe (Gosse, 1853, p. 340 as *A. vitrina* and p. 348 as *A. Forbesiana* (see Mayer, 1910, II, p. 323)).

Medusae. Gosse says "at least 10 species" were present in the water of Samson's Cave, Ilfracombe (1853, p. 334).

SCYPHOMEDUSAE

Order *Semaeostomae*

CHRYSOARA ISCÓCELES (L.)

Ilfracombe (Gosse, 1853, p. 364 as *C. cyclonota*): British Coasts (Haeckel, 1879 and Mayer, 1910). Mayer includes this species in *C. hysocella* Eschscholtz.

AURELIA AURITA (L.)

Oldbury, 25.8.1937 and 29.6.1939, taken in kypes: adults are common during August and early September in Portishead Dock (Purchon, 1937) and the species may breed in the dock (Matthews, 1923) although Purchon failed to find any of the scyphistoma stage: ephyrae were recorded from the plankton of Cardiff Roads in February, 1937 (Rees, 1939): all warm and temperate oceans (Mayer, 1910, p. 626).

PELAGIA CYANELLA Peron et Lesueur

An American species. The record from Ilfracombe by Gosse (1853, p. 378) is probably of this species (Mayer, 1910, II, p. 576).

ANTHOZOA

Sub-Class ALCYONARIA

ALCYONIUM DIGITATUM L.

Tunnel Rocks, Ilfracombe (Gosse, 1853, p. 434).

EUNICELLA VERRUCOSA (Pallas)

Generally distributed and fairly common on rocky ground 10-25 fathoms (Todd, 1906 as *E. cavolini* Koch).

Sub-Class ACTINIARIA

ACTINIA EQUINA L.

Fairly common at Blue Anchor (East) near M.T.L., 23.4.1940, at Kilve, 7.5.1939 and on the shore near the Old Pier at Weston, 19.4.1939 (but not found on Birnbeck Island): red, brown and strawberry varieties were noted at each place: Purchon (1937) recorded one small specimen from Portishead and none were seen in 1939 although Matthews records the species as fairly common in 1923: Yonge and Lloyd (1938) found red and dark green forms on Steepholm: Gosse (1853) records it from Ilfracombe: "The species sometimes occurs in estuaries" (Stephenson, 1935, II, p. 123).

ANEMONIA SULCATA (Pennant)

Common at Hele, Tunnel, Capstone and Lantern Hills, and White Pebble Bay, Ilfracombe; up to 6 inches in diameter between Capstone and Lantern Hills (Gosse, 1853, pp. 119, 267, 268, 330 and 435 as *Anthea cereus*): generally distributed and common on rocks between tidemarks (Todd, 1906): "West coast of . . . England" (Stephenson, 1935, II, p. 129).

TEALIA FELINA (L.)

Common at L.W.S.T. from Blue Anchor (East) to Portishead: rare on Steepholm (Yonge and Lloyd, 1938) and in the gully at Aust. The specimens from Blue Anchor and Kilve (and probably the others), agree with the description of var. *lofotensis* except for their small size and the absence of the outer, double ring of tentacles. The specimens are pale and translucent and—notably at Weston—are frequently buried in soft mud up to the disc level. Occasional specimens are taken in the kypes at Oldbury. "The species sometimes occurs in estuaries" (Stephenson, 1935, II, p. 154). The variety *coriacea* (Cuvier) is recorded from Ilfracombe (Wildersmouth, Tunnel Rocks and Hele) by Gosse (1853, p. 435). He found them good eating after boiling for ten minutes in sea water, but better if

fried in egg and breadcrumbs. *Anemonia sulcata* was not nearly so good (*loc. cit.* p. 150).

BUNNODACTIS VERRUCOSA Pennant

Not uncommon all around Ilfracombe (Gosse, 1853 and 1860 as *Actinia gemmacea*).

ANTHOPLEURA THALLIA (Gosse)

Ilfracombe (Gosse, 1860, as *Bunodes*).

AURELIANIA HETEROCERA (Thompson)

Ilfracombe (Gosse, 1860, as *A. angusta*).

CALLIACTIS PARASITICA (Couch)

Common off S.W. England; inter-tidal in some places (Stephenson, 1935, II, p. 244): generally distributed and common 15-30 fathoms in shells inhabited by *Eupagurus bernhardus* (Todd, 1906 as *Sagartia*).

ADAMSIA PALLIATA (Bohadsch)

Generally distributed and common 10-30 fathoms on shells inhabited by *Eupagurus prideauxi* (Todd, 1906): off S.W. England (Stephenson, 1935, II, p. 252).

SAGARTIA ELEGANS (Dalyell)

The species is "at its best in S.W. England, S. Wales and parts of Ireland" (Stephenson, 1935, II, p. 324).

Var. *miniata* (Gosse). This variety occurs wherever the species is found (Stephenson, *loc. cit.*): Ilfracombe (Gosse, 1860).

Var. *venusta* (Gosse). West and S.W. Great Britain (Stephenson, *loc. cit.*): Clovelly, on oysters from deep water (Gosse, 1860).

Var. *nivea* (Gosse). West and S.W. Great Britain (Stephenson, *loc. cit.*): Clovelly, Ilfracombe (Gosse, 1860).

SAGARTIA TROGLODYTES (Price)

Ilfracombe (Gosse, 1860).

Var. *ornata* Holdsworth. At Blue Anchor (East), 24.4.1940, several typical specimens in $\frac{1}{2}$ inch of mud on rock at M.T.L.: Yonge and Lloyd (1938) found three specimens on Steephholm in a pool which was only affected by spray: "Wide-spread; it may occur in brackish water in estuaries" (Stephenson, 1935, II, p. 341).

ACTINOTHOE ANGUICOMA (Price)

S.W. England (Stephenson, 1935, II, p. 362): Ilfracombe (Gosse, 1853, p. 119 as *Actinia*).

ACTINOTHOE SPHYRODETA (Gosse)

Ilfracombe (Gosse, 1860 as *Sagartia*): S.W. England, S.W. Ireland and apparently the Irish Sea (Stephenson, 1935, II, p. 347).

CEREUS PEDUNCULATUS (Pennant)

S.W. England, Wales, Irish Sea (Stephenson, 1935, II, p. 370): generally distributed and common in muddy sand, sometimes in great profusion in estuaries (Todd, 1906 as *Sagartia bellis*): Ilfracombe (Gosse, 1853, p. 118 and p. 435 as *Actinia bellis*).

CARYOPHYLLIA SMITHI Stokes

Abundant at L.W.S.T. all around Ilfracombe and Combe Martin Bay (Gosse, 1853).

CORYNACTIS VIRIDIS Allman

Generally distributed and common L.W. to 15 fathoms (Todd, 1906): Ilfracombe (Gosse, 1853, p. 424 as *C. almanni*).

BALANOPHYLLIA REGIA Gosse

Ilfracombe, common, L.W.E.S.T. (Gosse, 1853, p. 404).

Undetermined Anthozoa

Very small pale anemones occur at Blue Anchor and Kilve and are probably young *Tealia felina*. Some dead white specimens may, however, be another species.

CTENOPHORA**PLEUROBRACHIA PILEUS** (O. F. Müller)

Weston, Burnham and Stolford, December to May, in kypes or nets; this is the 'jelly' which must be abundant before a good run of sprats can be expected in the Weston nets (A. J. Lloyd): in the plankton of Cardiff Roads, common during June, July and August; rare during September, November and January (Rees, 1939).

Phylum **PLATYHELMINTHES****TURBELLARIA**Order **Tricladida****PROCERODES ULVAE** (Oersted)

Abundant under stones where a stream runs on to the shore at Kilve; egg capsules absent 18.8.1939 and 10.3.40, common 7.5.39.

Order **Polycladida****LEPTOPLANA TREMELLARIS** (O. F. Müller)

Blue Anchor (West), 23.4.1940, a few under stones M.T.L.

CESTODAOrder **Pseudophyllidae****LIGULA INTESTINALIS** (L.)

Oldbury, 1938 and 1939, the metacestode in *Gobius minutus* from

the kypes : in September, 1939, a high percentage of the fish were infected.

Phylum NEMERTINI

Order Anopla

LINEUS GESSERENSIS (O. F. Müller)

Typically coloured specimens (green and rose) are rare from Blue Anchor to Portishead. Darker specimens were obtained from under stones up to M.T.L. at Aust, while at Sheperdine on High Heron Rocks almost black specimens were abundant over a small area (26.3.1939 and 21.18.1939). Later, however, (14.3.1940) after the big frost no specimens were obtained from Sheperdine or Aust where they could not have been overlooked nor lower down river where they were always rare. After a mild winter a few specimens were collected from Sheperdine (28.3.1941), Portishead (29.3.1941) and Aust (1.4.1941). A dark fragment of a worm probably belonging to the species was collected at Sharpness (16.4.1939).

Other nemertines occur occasionally. Spawn has been taken in Portishead Dock.

Phylum CHAETOGNATHA

SAGITTA SETOSA J. Müller

In the plankton of Cardiff Roads, present in September, 1936, and May to August, 1937 (Rees, 1939).

Phylum ANNELIDA

ARCHIANNELIDA

DINOPHILUS

Specimens of this genus were taken at Kilve, 21.5.1939, from high tide pools.

POLYCHAETA

APHRODITE ACULEATA L.

Generally distributed and fairly common especially on fine sandy grounds (Todd, 1906).

HERMIONE HYSTRIX (Savigny)

Most common on gravel grounds (Todd, 1906).

LEPIDONOTUS SQUAMATUS (L.)

A few under stones near L.W.M. Blue Anchor to Portishead : generally distributed (Todd, 1906).

EUNOE NODOSA (M. Sars)

Portishead (Purchon, 1937).

HARMOTHOE IMBRICATA (L.)

Common under stones at L.W.M. from Blue Anchor to Weston: Matthews (1923) records it as fairly common at Portishead but it was not recorded in 1939 nor by Purchon in 1936 (Purchon, 1937).

HARMOTHOE IMPAR (Johnston)

Ilfracombe (Gosse, 1853, p. 391 as *Polynoe*).

ETEONE FLAVA (Fabricius)

Purchon (1937) records one specimen of this species from Portishead and Rees (1939) records *Eteone* sp. in the plankton of Cardiff Roads.

TOMOPTERIS HELGOLANDICA Greef

In two nettings (Todd, 1906): Ilfracombe, August (Gosse, 1853, p. 356 as *Johnstonella catharina*).

KEFERSTEINIA CIRRATA (Keferstein)

One specimen from Blue Anchor (East) 23.4.1940.

AUTOLYTUS sp.

Larvae occurred in the plankton of Cardiff Roads, March to July, 1937 (Rees, 1939).

NEREIS PELAGICA L.

Common under stones near L.W.M. at Blue Anchor (East), Kilve and Weston: absent at Portishead but present at Aust: young specimens were present in mud below M.T.L. at Blue Anchor (East) 23.4.1940.

NEREIS DIVERSICOLOR O. F. Müller

Abundant in mud and under stones on mud from Stolford to Purton: only a few were obtained at Arlingham Passage on 18.4.1939 and none later: at Kilve the species occurs in rock furrows above M.T.L. where fresh water flows over the beach, and at Blue Anchor one specimen was taken on 22.4.1940.

NEREIS VIRENS Sars

Portishead, common under stones near L.W.M. (Purchon (1937) and Matthews (1923)); not taken in 1939: Severn Beach, 3.11.1938, one in kype.

PLATYNEREIS DUMERILI (Audouin and Edwards)

Weston, February 1940, occasional in tubes on *Corallina officinalis* in rock pools M.T.L. (Ebling, 1940. Identified by D. P. Wilson).

NEPHTHYS HOMBERGI Lamarck

Common at Weston New Pier near M.T.L. in muddy sand with *Arenicola marina* and *Macoma balthica*, 22.4.1939: one taken at Blue Anchor (East), 23.4.1940: Purchon (1937) records it as common in mud at Portishead in 1936.

NEPHTHYS CIRROSA Ehlers

Blue Anchor (East), 23.4.1940, common in muddy sand above M.T.L. with *Arenicola marina*; small specimens in mud at and below M.T.L.

MARPHYSA SANGUINEA (Mongatu)

Blue Anchor (East), 23.4.1940, one small specimen.

LUMBRICONEREIS LATREILLI (Audouin and Edwards)

A few taken near L.W.M. at Kilve, 21.5.1939, and from mud below M.T.L. at Blue Anchor (East), 23.4.1940.

NERINE CIRRATULUS (Della Chiaje)

Blue Anchor (West), 23.4.1940, abundant in sand above M.T.L. with *Arenicola marina*. The associate of *Arenicola marina* at the other end of the bay (Blue Anchor (East)) is *Nephtys cirrosa*.

Larvae of *Nerine* sp. are recorded in the plankton of Cardiff Roads by Rees (1939).

PYGOSPIO ELEGANS Claparède

Sheperdine, 26.3.1939, tubes on the upper part of the beach; 2.4.1939, living specimens from near L.W.M.: Weston, 22.4.1939, some near L.W.M.: recorded by Purchon (1937) from Portishead.

POLYDORA CILIATA (Johnston)

Boring in limestone in pools high upon the shore at Steephholm (Yonge and Lloyd, 1938) and at Kilve: Blue Anchor (East), 23.4.1940, abundant in slate above M.T.L., breeding.

ARENICOLA MARINA L.

Abundant at Weston and Blue Anchor: Oldbury, 26.10.1938, one in kype.

ARENICOLA GRUBEI Claparède

Gossé (1853, p. 173) records *A. branchialis* from Ilfracombe, and Fauvel (1927) considers the record to be probably of *A. grubei*.

SABELLARIA ALVEOLATA (L).

Grows abundantly at L.W.M. on rock at Kilve and Weston (Birnbeck Island): at Weston it spreads on to shingle nearer M.T.L.

and covers an extensive area : it is present at Stolford and rare at Blue Anchor (East) : Matthews (1923) recorded it as common at Portishead but Purchon (1937) found the reef uninhabited in 1936 ; it was not seen in 1939 : Gosse (1853) reports the species from Ilfracombe (as *Sabella*).

AMPHITRITE JOHNSTONI Malmgren

In mud tubes under stones and on rock at L.W.M. at Weston and Portishead : a flourishing colony observed at Aust (22.3.1939) later disappeared and was not present in August 1939 or March 1940. Matthews' (1923) record of *Amphitrite* sp. "Common at low spring tides at Portishead" is undoubtedly of this species.

TEREBELLA LAPIDARIA L.

L.W.S.T. Portishead (Purchon, 1937).

BRANCHIOMMA VESICULOSUM (Montagu)

Ilfracombe (Gosse, 1853, p. 417 as *Sabella*).

HYDROIDES NORVEGICA Gunnerus

Occasional small tubes have been seen at Blue Anchor, Weston, Aust and Sheperdine.

POMATOCEROS TRIQUETER (L.)

One small tube at Weston.

MERCIERELLA ENIGMATICA

Portishead Dock, 1936, abundant on a steel hull, probably introduced on the ship (Purchon, 1937).

Polychaete larvae. Abundant in the plankton of Cardiff Roads with a small peak in March and a larger one in June and July, absent only in December (Rees, 1939).

OLIGOCHAETA

A few specimens of this order have been collected in various parts of the estuary but no attempt has been made to collect representative samples or to identify those taken.

HIRUDINEA

GLOSSOSIPHONIA COMPLANATA L.

Ashleworth Ferry, 22.8.1939, three.

HERPOBDELLA OCTOCULATA L.

Ashleworth Ferry, 22.8.1939, one.

Phylum GEPHYREA

PHASCOLOSOMA ELONGATUM Keferstein

Blue Anchor (East), 23.4.1940, one under stone in mud below M.T.L.

PHASCOLOSOMA VULGARE (de Blainville)

Ilfracombe at Wildersmouth, 1852, one at L.W.M. (Gosse, 1853, p. 157 as *Syrinx harveii*).

Phylum ARTHROPODA

CRUSTACEA

Nauplii (other than those of Cirripedes)

In the plankton of Cardiff Roads, absent in September, 1936, common or abundant from October 1936 to August, 1937, with peaks in February and May (Rees, 1939).

Sub-Class BRANCHIOPODA

EVADNE NORDMANNI Lovén

Frequent and at times common off our coasts (Norman and Scott, 1906, p. 109).

PODON POLYPHEMOIDES Leuckart

In plankton of Cardiff Roads, June, 1937, abundant (Rees, 1939).

Sub-Class OSTRACODA

Ostracods have not been sought and, except for one specimen taken in debris at Blue Anchor, have not been found. In the following list all records are for *Ilfracombe* and are from Norman and Scott, 1906, *except where otherwise stated*.

PHILOMEDES INTERPUNCTA (Baird) (Stebbing, 1906a).

ASTEROPE MARIAE (Baird) (Stebbing, 1906a).

ASTEROPE TERES (Norman)

PONTOCYPRIS TRIGONELLA G. O. Sars

PARACYPRIS POLITA G. O. Sars

BAIRDIA INFLATA (Norman) Devonshire Coast, 60 fathoms.

BAIRDIA ACANTHIGERA Brady Devonshire Coast, 60 fathoms

CYTHERIDEA ANGUSTATA (Münster) as *Cythere elongata*

CYTHERIDEA TOROSA (Rupert Jones)

Weston-super-Mare (Stebbing, 1906b).

EUCYTHERE DECLIVIS (Norman)

Variety *argus* Brady and Robertson.

Variety *prava* Brady and Robertson.

CY THERE LUTEA (Müller)

CY THERE PORCELLANEA Brady

CY THERE TENERA G. S. Brady

CY THERE SEMIPUNCTATA Brady

CY THERE ALBOMACULATA Baird

Common between tide marks all round the (Cornish and Devon) coast.

CY THERE CRISPATA G. S. Brady

CY THERE ROBERTSONI Brady

CY THERE CONVEXA Baird

CY THERE CUNEIFORMIS G. S. Brady

LEPTOCY THERE PELLUCIDA (Baird) as *Cythere confusa*

LEPTOCY THERE MACALLANA (Brady and Robertson) as *Cythere*

HEMICY THERE VILLOSA (G. O. Sars) as *Cythere*

HEMICY THERE QUADRIDENTATA (Baird) as *Cythere*

HEMICY THERE OBLONGA (Brady) as *Cythere*

CY THEREIS EMACIATA (Bady) as *Cythere*

CY THEREIS TUBERCULATA (G. O. Sars)

Devonshire Coast (Stebbing, 1906a).

CY THEREIS FINMARCHICA (G. O. Sars) as *Cythere*

CY THERURA SELLA G. O. Sars

CY THERURA STRIATA G. O. Sars

CY THERURA PRODUCTA G. S. Brady

CY THERURA NIGRESCENS (Baird)

Everywhere between tide marks.

CY THERURA CELLULOSA (Norman)

LOXOCONCHA IMPRESSA (Baird)

LOXOCONCHA GUTTATA (Norman)

LOXOCONCHA TAMARINDUS (T. R. Jones)

LOXOCONCHA MULTIFLORA (Norman)

CY THEROPTERON NODOSUM G. S. Brady

BYTHOCY THERE CONSTRICTA G. O. Sars

XESTOLEBERIS AURANTIA (Baird)

XESTOLEBERIS DEPRESSA Sars

PARACY THEROIS FLEXUOSA G. S. Brady as *Paradoxostoma flexuosum*

SCLEROCHILUS CONTORTUS (Norman)

CY THERIDEIS SUBULATA G. S. Brady

CY THEROIS FISCHERI (G. O. Sars)

PARADOXOSTOMA VARIABILE (Baird)

Everywhere between tide marks in shallow water.

PARADOXOSTOMA ENSIFORME G. S. Brady
 PARADOXOSTOMA ABBREVIATUM G. O. Sars
 PARADOXOSTOMA OBLIQUUM G. O. Sars
 PARADOXOSTOMA NORMANI G. S. Brady
 PARADOXOSTOMA PULCHELLUM (G. O. Sars)

Norman and Scott (1906, p. 119) record *Cythere pulchella* Brady.

PARADOXOSTOMA HIBERNICUM G. S. Brady
 PARADOXOSTOMA ARCUATUM G. S. Brady

Sub-Class COPEPODA

These records are mainly from a series of plankton hauls taken by C. B. Rees (1939) at regular intervals from September, 1936, to August, 1937. It may be assumed therefore that the copepods were absent during any month not mentioned below. When records are from other sources the reference is given.

Sub-Order *Calanoida*

CALANUS FINMARCHICUS (Gunnerus)

One specimen in each of February, March and April, 1937.

PSEUDOCALANUS ELONGATUS Boeck

Present from January to June, common in April, 1937.

CENTROPAGES HAMATUS (Lilljeborg)

Common in September, 1936, present in November and December, 1936, and in May and July, 1937.

TEMORA LONGICORNIS (O. F. Müller)

Present in December, 1936, January and February, 1937.

EURYTEMORA AFFINIS (Poppe)

Present in September, 1936, rising to a considerable peak-abundance in April and falling to complete absence in August, 1937.

ACARTIA BIFILOSA (Giesbrecht)

September, 1936, common; October and November, 1936, present; December, 1936, to April, 1937, absent; increasing rapidly in May to a maximum abundance in June, 1937; falling away in July and August, 1937.

Sub-Order *Harpacticoida*

LONGIPEDIA MINOR Scott Present.

CANUELLA PERPLEXA Scott Present.

ECTINOSOMA CURTICORNE Boeck Present.

ZAUS GOODSIRI Brady	Present.
ALTEUTHA INTERRUPTA (Goodsir)	Present.
PELTIDIUM PURPUREUM Philippi	
Ilfracombe (Stebbing, 1906a).	
IDYA FURCATA (Baird)	Present (as <i>Tisbe</i>)
PSAMATHE LONGICAUDA Philippi	
Ilfracombe (Stebbing, 1906a).	
TACHIDIUS BREVICORNIS Lilljeborg	Present (as <i>T. discipes</i>).
TACHIDIUS LITTORALIS Poppe	Present.
EUTERPINA ACUTIFRONS (Dana)	

September to December, 1936, in decreasing abundance; January to April, 1937, absent; from May rising to a peak abundance in August, 1937.

Sub-Order *Cyclopoida*

OITHONA NANA Giesbrecht

September and December, 1936, common; November, 1936, January, February and July, 1937, present.

NICOTHOE ASTACI Andouin and Milne-Edwards

Common at Ilfracombe (Stebbing, 1906a).

MACROCHEIRON FUCICOLUM Brady Present.

Sub-Order *Monstrilloida*

CYMBASOMA RIGIDUM J. C. Thompson

Ilfracombe (Stebbing, 1906a).

Sub-Order *Caligoida*

LEPEOPHTHEIRUS THOMPSONI Baird

Ilfracombe on turbot and brill (Stebbing, 1906a).

LEPEOPHTHEIRUS SALMONIS (Kröyer)

Ilfracombe on salmon (Stebbing, 1906a).

Sub-Order *Lernaeoida*

LERNEA LUSCI Bassett-Smith

Gills of *Gadus merlangus*, in kypes at Oldbury, 1938.

LERNAEENICUS SPRATTAE (Sowerby)

Eye of *Clupea sprattus*, Oldbury kypes, 1938 and Weston nets, 1941.

SPLANCHNOTROPHUS GRACILIS Hancock and Norman

On *Acanthodoris pilosa*, coast of Devonshire (Stebbing, 1906a).

Sub-Class CIRRIPIEDIA

Order Thoracica

LEPAS ANATIFERA L.

Ilfracombe on floating bottle (Stebbing, 1906a).

CHTHAMALUS STELLATUS (Poli)

North Devon (Stebbing, 1906a): Lee Bay near Ilfracombe, October, 1935, abundant; Clevedon, June, 1938, and Blue Anchor Bay, November, 1935, absent (Moore and Kitching, 1939).

BALANUS PERFORATUS Brugière

Very common at low water on rocks from Portishead to Clevedon and at Brean Down (Matthews, 1923). It is curious that Matthews does not record *B. improvisus* which in 1939 and 1940 was abundant throughout this region while *B. perforatus* was not seen.

BALANUS BALANOIDES (L.)

Fairly common at Blue Anchor and Kilve: rare on Steephelm (Yonge and Lloyd, 1938) and at Weston (where it was not present on Birnbeck Island (Ebling, 1940)).

BALANUS IMPROVISUS Darwin

Blue Anchor (West), 23.4.1940, L.W.S.T. abundant but dead: Blue Anchor (East), 22.4.1940, dead specimens common at L.W.M.; others in a gully were alive but sparse: Kilve, 7.5.1939, not common; 10.3.1940, all but one dead: Weston, 22.4.1939, abundant but small; February, 1940, no living ones seen: Portishead, abundant but small (Purchon, 1937); 11.3.1940, alive: Aust, 22.3.1939, common; 9.3.1940, many alive: Sheperdine, 26.3.1939, a few in a gully: Sharpness, 24.8.1939, a few large specimens on the wall of the tidal basin.

Order Acrothoracica

SACCULINA sp.

Oldbury, 1938, on *Portunus holsatus* in kype.

Nauplii

Cardiff Roads plankton, September, 1936, abundant; December, 1936, and January, 1937, absent; February to August, 1937, abundant with large peak in March (Rees, 1939).

Cypris larvae

Cardiff Roads plankton, September, 1936, and May, 1937, common. November, 1936, and June, 1937, present; December, 1936, January to April and July and August, 1937, absent (Rees, 1939).

Sub-Class MALACOSTRACA

Order Cumacea

DIASTYLIS RATHKEI (Kröyer)

Kilve, many females taken in hand net at L.W.M.; 7.5.1939, common; 21.5.1939, abundant (also taken from soft mud at M.T.L.); 18.8.1939 and 10.3.1940, none: Stolford, 9.6.1939 in nets: identified by R. Dennell: Cardiff Roads bottom plankton, 1936-1937, occasional (Rees, 1939).

PSEUDOCUMA LONGICORNIS (J. V. Thompson)

Ilfracombe, common (Norman and Scott, 1906, p. 32).

CUMELLA PYGMAEA G. O. Sars

Ilfracombe (Norman and Scott, 1906, p. 33).

TANAIS CAVOLINI Milne-Edwards

Ilfracombe (Norman and Scott, 1906, p. 34).

TANAISsus LILLJEBORGI (Stebbing)

Ilfracombe, male (females at Woolacombe and Lee) (Norman and Scott, 1906, p. 35).

Order Isopoda

ANTHURA GRACILIS (Montagu)

Ilfracombe (Norman and Scott, 1906, p. 36).

CYATHURA CARINATA (Kröyer)

Single specimens at L.W.M. from Sharpness, 16.4.1939, Sheperdine, 21.8.1939, and Kilve, 21.5.1939: a few specimens under stones on mud near M.T.L. Blue Anchor (West), 23.4.1940: all female.

GNATHIA MAXILLARIS (Montagu)

Common on the coasts of Devon and Cornwall (Norman and Scott, 1906, p. 37).

EURYDICE PULCHRA Leach

Taken in hand net at L.W.M. Arlingham, August 1940, rare: Portishead, 1936, rare (Purchon, 1937); 19.8.1939, rare: Weston, 17.8.1939, common: Kilve, 7.5.1939, rare: Cardiff Roads plankton, 1936, rare (Rees, 1939). The species was also taken in a salt marsh pool at Sheperdine, 21.8.1939, together with caddis larvae, in water of salinity 22 parts per thousand. It was absent from the same pool on 14.3.1940 when the salinity was 8 parts per thousand.

EURYDICE SPINIGERA H. J. Hansen

Ilfracombe (Norman and Scott, 1906, p. 43).

LIMNORIA LIGNORUM (Rathke)

Found attacking the piles of the north extension of Weston Old Pier together with a few *Chelura terebrans*, 22.4.1939. Purchon (1937) records *Limnoria* from Portishead Dock and on driftwood on the beach—but no *Chelura*.

SPHAEROMA SERRATUM (Fabricius)

Found from M.T.L. to L.W.M. Common at Portishead, Aust and Sheperdine: rarer at Kilve and Sharpness. In collections made in August, 1939, G. M. Spooner distinguished between the large 1938 brood and the small but more numerous 1939 brood.

SPHAEROMA RUGICAUDA Leach

Specimens with an unusually smooth dorsal surface were taken from the breakwater (rare) and a salt marsh pool (abundant) at Tites Point, Purton, 18.4.1939. Other records are a few stranded in sand at Arlingham Passage, 18.4.1939, a few netted in Portishead Dock, 19.8.1939, and one specimen from Purchon's collection on Royal Beach, Portishead (Purchon, 1937). Jones (1865) records the abundance of *Sphaerosoma dentata* in salt marsh pools north of Sharpness.

SPHAEROMA HOOKERI Leach

Clevedon (Stebbing, 1906b).

CYMODOCE TRUNCATA (Montagu)

Found all along the coasts of Devon and Cornwall (Norman and Scott, 1906, p. 45).

NAESA BIDENTATA (Adams)

Abundant in salt marsh pools north of Sharpness (Jones, 1865, p. 142).

IDOTEA GRANULOSA (Rathke) (Collinge, 1917).

Males and females have been taken in small numbers (mainly by hand net) from between M.T.L. and L.W.M. from Weston to Sheperdine

IDOTEA LINEARIS (L.)

One female from the shrimp nets at Stolford, 10.6.1939.

IDOTEA VIRIDIS (Slabber)

Sheperdine, two, M.T.L.: Aust gully, one, August, 1939: Portishead, common (Purchon, 1937): Steephholm, a few in a high tide pool (Yonge and Lloyd, 1938).

STENOSOMA LANCIFERUM Leach

Ilfracombe (Norman and Scott, 1906, p. 47).

ARCTURELLA DAMNONIENSIS (Stebbing)

Ilfracombe (Norman and Scott, 1906, p. 48).

JANIRA MACULOSA Leach

Common under stones near L.W.M. at Blue Anchor and Kilve : less common at Weston : Ilfracombe (Norman and Scott, 1906, p. 48).

JAERA ALBIFRONS (=MARINA) (Fabricius)

Common about M.T.L. from Blue Anchor to Sharpness : common under stones between tide marks (Norman and Scott, 1906, p. 48).

MUNNA FABRICII Kröyer

Ilfracombe, 1904 (Norman and Scott, 1906, p. 49).

LIGEA OCEANICA (L.)

Recorded from Ilfracombe (Gosse, 1853), Sharpness (Jones, 1865), Denny Island (Matthews, 1922 and 1932) and Steephholm (Yonge and Lloyd, 1938). Taken in suitable places during 1939 from Lynmouth to Sharpness.

BOPYRUS SQUILLARUM Latreille

Common on *Palaemon serratus* (=Leander) (Norman and Scott, 1906, p. 51).

BOPYRUS GIARDI Bonnier

On *Hippolyte varians* at Ilfracombe (Norman and Scott, 1906, p. 51).

HEMIONISCUS BALANI (Spence Bate)

In *Balanus balanoides*, Blue Anchor, 23.4.1940.

CRYPTONISCID

In Cardiff Roads plankton, March and July, 1937 (Rees, 1939). Other *Isopoda* of terrestrial habit have been taken at Aust, METOPONORTHUS PRUINOSUS (Brandt); at Aust and Portishead, ONISCUS ASELLUS (L.) and PORCELLIO SCABER (Latreille) and at Aust and Denny Island (Matthews, 1932), ARMADILLIDIUM VULGARE (Latreille).

Order Amphipoda**LYSIANASSA CERATINA** A. O. Walker

Ilfracombe (Norman and Scott, 1906, p. 56 as *Lysianax ceratinus*).

TRYPHOSELLA SARSI (Bonnier)

Ilfracombe, 1904 (Norman and Scott, 1906, p. 59).

AMPELISCA sp.

Blue Anchor (East), 22.4.1940, one.

BATHYPOREIA GUILLIAMSONIANA (Bate)

Ilfracombe, 5½ miles offshore, 1904 (Norman and Scott, 1906, p. 60).

BATHYPOREIA PELAGICA Bate

Blue Anchor (East), 23.4.1940, one in sand, H.W.N.T.: Ilfracombe (Norman and Scott, 1906, p. 61).

BATHYPOREIA ELEGANS Watkin (Watkin, 1938).

Kilve, 21.5.1939, one young male in hand net, L.W.M.

BATHYPOREIA PILOSA Lindstrom (Watkin, 1938).

Arlingham Passage, 22.8.1939, two females, two immature in hand net, L.W.M.

HAUSTORIUS ARENARIUS (Slabber)

Blue Anchor (West), 23.4.1940, one in sand, H.W.N.

METOPA PUSILLA G. O. Sars

Ilfracombe, 1904 (Norman and Scott, 1906, p. 66).

PONTOCRATES NORVEGICUS Boeck

Ilfracombe (Norman and Scott, 1906, p. 69).

SYNCHELIDIUM HAPLOCHELES Grube

Ilfracombe (Norman and Scott, 1906, p. 68).

APHERUSA JURINEI (H. Milne-Edwards)

Ilfracombe (Norman and Scott, 1906, p. 76).

CALLIOPIUS CRENULATUS Chevreux et Fage

At Portishead, 19.8.1939 and 11.3.1940, abundant in pools and channel at L.W.M.; 19.8.1939, present in Dock: at Weston, 18.8.1939, abundant at L.W.M. and in pools above M.T.L.; 10.2.1940, rare at L.W.M.: at Kilve, May and August, 1939, a few at L.W.M.

CALLIOPIUS LAEVIUSCULUS (Kröyer)

Weston, 20.4.1939, a few, probably of this species.

NEOPLEUSTES BICUSPIS (O. Sars) (= *Paramphithoe bicuspis*).

Kilve, 18.8.1939, two (probably this species) at L.W.M.: Ilfracombe (Norman and Scott, 1906, p. 72).

NOTOTROPIS SWAMMERDAMI (H. Milne-Edwards)

In plankton of Cardiff Roads, December, 1936, one (Rees, 1939): Ilfracombe (Norman and Scott, 1906, p. 77 as *Paratylus*).

GAMMARELLUS HOMARI (Fabricius)

At Weston, 22.4.1939, common under stones at L.W.S.T.; 10.2.1940, immatures rare at L.W.M.: at Portishead, 1936, rare (Purchon, 1937):

at Kilve, 21.5.1939, rare : at Stolford, 9.6.1939 and 20.5.1939, rare in hose nets : in plankton of Cardiff Roads, January, February and March, 1937, rare (Rees, 1939) : Ilfracombe (Norman and Scott, 1906, p. 79 as *Amathilla*).

EUCRANGONYX GRACILIS

Frequent in the Severn at Tewkesbury (Sexton, 1939).

MEGALUROPUS AGILIS Hoeck

Ilfracombe (Norman and Scott, 1906, p. 81).

MELITA PALMATA (Montagu)

Always near M.T.L. Aust, 22.3.1939, fairly common : Portishead, 19.8.1939, rare : Weston, 17.8.1939, rare : Kilve, 7.5.1939 and 10.3.1940, rare : Ilfracombe (Norman and Scott, 1906, p. 79).

MAERA OTHONIS (M. Edwards)

Ilfracombe (Norman and Scott, 1906, p. 81).

Gammarus species

Special attention has been given to the distribution and identification of species of *Gammarus*. Here the records are given. Their significance will be discussed elsewhere.

MARINOGAMMARUS MARINUS

At Sharpness, 16.4.1939, one M.T.L. : at Sheperdine, 26.3.1939, common at M.T.L., rare at L.W.M. and H.W.M. ; 21.8.1939, common at M.T.L. (all sizes) and common at H.W.M. (young only) ; 14.3.1940, abundant at M.T.L., present at H.W.M. ; all were large specimens, none were immature and very few females were breeding ; other females show intersex characters : at Aust, 22.3.1939, 16.8.1939 and 9.3.1940, common at M.T.L. ; in 1940 only one breeding female was taken and the others showed intersex characters ; very few immatures present ; 9.3.1940, a few in the gully, not breeding : at Portishead (Royal Beach), present in 1936 (Purchon, 1937) ; 19.8.1939, common M.T.L. (mainly adult) and common H.W.M. (mainly young) ; 11.3.1940, abundant near H.W.M. ; nearly all were adults of average size ; all but one female show reduced brood plates and no eggs ; the one female had eggs : at Weston, 17.8.1939, one, M.T.L. : at Kilve, 7.5.1939, adults common under stones, breeding, M.T.L. : at Blue Anchor, 23.4.1940 (East), abundant near Pillars at H.W.M. and a few at M.T.L., nearly all adult ; (West), a few at M.T.L.

MARINOGAMMARUS OBTUSATUS (Dahl)

Found under stones near M.T.L. : at Weston, 20.4.1939 and

10.2.1940, adults only; 17.8.1939, adults and immature: at Steep-holm, a few (Yonge and Lloyd, 1938): at Kilve, 7.5.1939, common; 10.3.1940, breeding adults only; 18.8.1939, abundant immatures with adults; 10.3.1940, one at L.W.M.: at Blue Anchor (East), 22.4.1940, abundant, (West), 23.4.1940, common; immatures very rare and females with eggs, one brood ready for extrusion.

GAMMARUS LOCUSTA (L.)

At Weston, 17.8.1939, one immature M.T.L.: at Kilve, 21.5.1939, L.W.M., 18.8.1939, H.W.M., rare: in plankton of Cardiff Roads, 1936, one in September (Rees, 1939). The record by Matthews (1923) is probably of a mixture of species.

AMMARUS DUEBENI Lilljeborg

GAMMARUS CHEVREUXI Sexton

G These two species have not been found.

GAMMARUS ZADDACHI Sexton

This species is the commonest amphipod in the estuary. G. M. Spooner has discriminated three varieties. (1) *Typical* (i.e., 'normal' or 'hairy') extending into fresh water, (2) *Saline variety A* which he has also recorded from South-West England and Ireland and (3) *Saline variety B*. This latter variety is (as yet) peculiar to the Severn and in the main takes the place which, in the Tamar, is occupied by Var. A. In the Severn, Var. A is much rarer than B. At some stations the two intergrade and cannot be separated. These mixtures are recorded as Var. (BA) under Var. B.

GAMMARUS ZADDACHI Sexton *Typical variety* Spooner (*in lit.*)

At Ashleworth Ferry, 22.8.1939, common, a breeding population; 8.3.1940, common, females with rudimentary gills and inhibited development, some immatures present: at Gloucester West, 22.8.1939, a large immature population; 8.3.1940, not common, females show rudimentary gills and inhibited development, some immatures present: at Wier Green, 8.3.1940, not common, males, females without eggs and advanced immatures: at Elmore Back, 22.8.1939, rare: in a freshwater stream at Elmore Back, 22.8.1939, abundant but all immature: in the Berkeley Canal near Elmore, 22.8.1939, a few immature: at Epney, 18.4.1939, rare, adult 22.8.1939, rare, mainly immature; 8.3.1940, commoner, mainly adult, females with full pouches: in stream between Epney and Saul, 22.8.1939, a large population with relatively few females and only one with eggs; 22.2.1940, much rarer, only one immature taken,

females with eggs : at Arlingham Passage, 18.4.1939, one male and one female ; 22.8.1939, one immature ; 8.3.1940, none : at Sharpness, 16.4.1939, one female in pool at M.T.L. ; 24.8.1939, common at L.W.M. under stones, rare at M.T.L., only two immatures, females small but with eggs ; 16.3.1940, one large female : at Sheperdine, 26.3.1939, one male at L.W.M. ; 14.3.1940, one large female with eggs : at Oldbury, 20.5.1939, several good sized specimens in kypes : at Aust, 22.3.1939, one male at L.W.M. ; 16.8.1939, one large female in gully ; 9.3.1940, rare in gully, present on breakwater, adults only, females with eggs : at Kilve, 7.5.1939, H.W.M., in stream in furrow, abundant, two size groups apparent, some immatures present ; 18.8.1939, H.W.M. in stream, a few young adults, immatures abundant ; 200 yds. along at H.W.M., immatures abundant, adults present but dwarfed, females with eggs ; 10.3.1940, in the stream 100 yds. above the H.W.M. pool, a few ; H.W.M. in stream, immatures very rare, adults abundant, nearly all females with large broods of eggs or young ; a similar population 200 yds. along shore. The species is also recorded from a rhine south of Bristol which runs into the R. Yeo.

GAMMARUS ZADDACHI Sexton *Saline variety A.* Spooner (*in lit.*)

At Sharpness, 24.8.1939, at M.T.L., two males, eight immatures : at Sheperdine, 21.8.1939, present at L.W.M. and M.T.L. but mixed with *Saline var. B* and intermediates (BA) ; 14.3.1940, L.W.M. and M.T.L., a few, mainly adult ; of the 9 females taken, one had eggs and the others showed inhibited development : at Aust, 16.8.1939, a few adults at L.W.M., one male in the gully, commoner at H.W.M. by the Old Jetty (mixed with *Variety B* here) ; 9.3.1940, rare on the breakwater and reef at L.W.M., one female only with eggs ; 9.3.1940, common in the gully : at Portishead, 19.8.1939, one female at M.T.L., a few adults at L.W.M. : at Kilve, 7.5.1939, rare at L.W.M., common at M.T.L., adults only, breeding ; 21.5.1939, rare at L.W.M. ; 18.8.1939, rare at L.W.M. and at M.T.L. ; 10.3.1940, abundant at M.T.L., no immatures, most females with eggs.

GAMMARUS ZADDACHI Sexton *Saline variety B.* Spooner (*in lit.*)

At Sharpness, 16.4.1939, rare under stones at L.W.M., immatures abundant at M.T.L., adults absent ; 24.8.1939, under stones at M.T.L. and L.W.M., immatures abundant, young males common, females absent ; 16.3.1940, eight females showing inhibited development, six immatures, three males and one intermediate (BA) female : at Sheperdine, 26.3.1939, common at L.W.M. ; 21.8.1939, a breeding

population at M.T.L. and L.W.M., mainly immatures at L.W.M.—some specimens show intermediate (BA) characters; 14.3.1940, at L.W.M. 10 males, 13 females showing inhibited development, and 19 immatures; at M.T.L., rare: 14.3.1940, specimens showing intermediate (BA) characters occurred at L.W.M. and rarely at M.T.L. and H.W.M.; from L.W.M. of six (BA) females two had eggs and six showed inhibited development: at Oldbury in kypes, 20.5.1939, one immature; 27.2.1939 and 11.3.1939, a few; 20.3.1940, six males: at Aust, 22.3.1939, common under stones in gully, rarer under stones on mud at M.T.L., immatures present; on breakwater at L.W.M. males and immatures common, females absent; 16.8.1939, abundant at L.W.M. on breakwater, reef and on *Tubularia*, rare in gully, present near Old Jetty at H.W.N. but not easily separated from *Variety A*; 9.3.1940, at L.W.M., a large population with a few intermediates (BA) and signs of inhibition of reproduction and of intersexuality; 9.3.1940, common in gully, also with intermediates (BA): at Portishead, present, some intermediate (BA) (Purchon, 1937); 29.3.1939, one male in Dock; 19.8.1939, at L.W.M. a breeding population, common; 19.8.1939, in Dock, a few immatures; 11.3.1940, at L.W.M., adults abundant, some females with eggs, some specimens intermediate with *Variety A*, immatures very rare: at Weston, 22.4.1939, two immatures at L.W.S.T.; 17.8.1939, type sample of *Variety B* from L.W.M. on Birnbeck Island, no immatures present—also taken at L.W.S.T. and on *Tubularia*; 10.2.1940, one male intermediate (BA): at Stolford in hose nets, 9.6.1939, a good sample: at Kilve, 7.5.1939 and 21.5.1939, one immature at L.W.M. and one at M.T.L.; 18.8.1939, one female and one male at L.W.M.; 10.3.1940, a few adults at M.T.L.: at Blue Anchor, 23.4.1940, a few 'ultra-typical' adults from L.W.S.T. (West), two females with eggs.

GAMMARUS STOERENSIS Reid

At Kilve, 7.5.1939, a few at H.W.M. in stream in furrow, one immature; 10.3.1940, under stones at M.T.L. immatures absent, adults abundant—of 40 females 7 had eggs and 33 showed inhibited development of the brood plates, males 5 to 6 mm. in length, females with eggs 6 to 7 mm. and other females 6 to $7\frac{1}{2}$ mm.: at Blue Anchor (East), 22.4.1940, one female near Pillars at H.W.M.

GAMMARUS PULEX (L.)

In fresh water stream at Kilve, 18.8.1939 and 10.3.1940, a few above H.W.M.: rare at Tewkesbury (Sexton, 1939). It occurs commonly in fresh waters around Bristol.

GAMMARUS TIGRINUS Sexton

Common at Tewkesbury. (Sexton, 1939).

TRITAETA GIBBOSA (Bate)

Ilfracombe (Norman and Scott, 1906, p. 78).

DEXAMINE SPINOSA (Montagu)

Clevedon (Stebbing, 1906b).

TALITRUS SALTATOR (Montagu)

Sharpness, abundant (Jones, 1865 as *T. locusta*): Oldbury, 20.5.1939, one in shrimp kypes: Portishead, common H.T.M. (Purchon, 1937): Kilve, 18.8.1939, one, H.W.M.: abundant all along the coast at H.W.S.T. (Matthews, 1923 as *T. locusta*): common on sandy shores (Norman and Scott, 1906, p. 55 as *T. locusta*).

ORCHESTIA MEDITERRANEA A. Costa

At Portishead, 11.3.1940, one male.

ORCHESTIA GAMMARELLA (Pallas)

Tites Point, Purton, 18.4.1939, common under one lot of stones at H.W.M.: Sharpness, 16.4.1939, common at H.W.M.: Aust, 23.2.1939, abundant H.W.M. and cliff: Portishead, 1936, common (Purchon, 1937); 29.3.1939, abundant: in Portishead Dock, 19.8.1939, one: Kilve, 7.5.1939, present H.W.M.: Blue Anchor (West), 23.4.1930, abundant: "Abundant everywhere" (Matthews, 1923 as *O. littorea*): common, stony shores (Norman and Scott, 1906, p. 55 as *O. littorea*).

TALORCHESTIA DESHAYESEI (Andouin)

Aust, 6.5.1939, abundant in sand at H.W.M.: shores of North Devon (Norman and Scott, 1906, p. 55).

HYALE NILSSONI (Rathke)

Sheperdine, 21.8.1939, rare M.T.L.; 26.3.1939, rare H.W.M.: Aust, 9.3.1940, near the Old Jetty, one male: Portishead, present (Purchon, 1937): Weston, 17.8.1939, one in pool above M.T.L.: Blue Anchor (East), 22.4.1940, present.

EURYSTHEUS MACULATUS (Johnston)

Ilfracombe (Norman and Scott, 1906, p. 89).

AMPHITHOË RUBRICATA (Montagu)

Kilve, 10.3.1940, one female in tube L.W.S.T. on reef: Stolford, 20.5.1939, one male in hose nets: Blue Anchor, 23.4.1930, (East), common at M.T.L. and below, breeding; (West), one female at L.W.S.T.: common between tide marks (Norman and Scott, 1906, p. 90).

JASSA FALCATA (Montagu)

Ilfracombe (Norman and Scott, 1906, p. 92 as *Bruzeliella*).

JASSA OCIA (Bate)

Ilfracombe, type specimen taken by Gosse at L.W.M. (Norman and Scott, 1906, p. 93).

CERAPUS WHITEI

Ilfracombe, on *Chondrus crispus* at L.W.M. (Gosse, 1853, p. 384).

COROPHIUM VOLUTATOR (Pallas)

Arlingham Passage, 18.4.1939, a few at M.T.L.: Tites Point, Purton, 18.4.1939, a few in salt marsh pool with *Sphaeroma rugicauda*: Sharpness, 16.4.1939, a few: Aust, 19.3.1939, one: Portishead, rare (Purchon, 1937): Kilve, 21.5.1939, one in hand net at L.W.M. Fishermen look for this species hopping over the mud and set their trammels and long nets for taking fish near by (A. J. Lloyd).

COROPHIUM BONELLI (H. Milne-Edwards)

"Plentiful among weeds at the inner end of Portishead Dock" (Matthews, 1923). There has been much confusion between this and the following species (see Crawford, 1937) and this record may actually be of *C. acherusicum*. Purchon's specimens of the latter were identified by Crawford.

COROPHIUM ACHERUSICUM da Costa

Ashleworth Ferry, 22.8.1939, several: in the Berkeley Canal near Elmore, 22.8.1939, one: in Portishead Dock, 1936, common (Purchon, 1937).

COROPHIUM INSIDIOSUM Crawford (1937)

At Portishead, common in the Dock on weeds (Purchon 1937).

COROPHIUM n. sp.

Haw Bridge, 8.3.1940, several males: Ashleworth Ferry, 8.3.1940, one male. This is a new species to be described by G. M. Spooner.

CHELURA TEREBRANS Philippi

At Weston, 22.4.1939, in piles of Old Pier (North Extension), a few with *Limnoria*.

DULICHIA PORRECTA (Sp. Bate)

Ilfracombe (Norman and Scott, 1906, p. 97).

DULICHIA FALCATA Bate

Ilfracombe (Norman and Scott, 1906, p. 97).

HYPERIA GALBA (Montagu)

With the jellyfish *Chrysoara*, Ilfracombe (Gosse, 1853, p. 367, as *H. medusarum*).

CAPRELLA ACUTIFRONS Latreille

Ilfracombe (Norman and Scott, 1906, p. 99).

CAPRELLA LINEARIS (L.)

Ilfracombe (Norman and Scott, 1906, p. 98).

CAPRELLA FRETENSIS Stebbing

Ilfracombe (Norman and Scott, 1906, p. 99).

CAPRELLA sp.

Kilve, 22.5.1939, a few; 18.8.1939, abundant: Blue Anchor (East), 23.4.1940, one. This *Caprella*, taken at L.W.S.T. on *Tubularia indivisa*, differs slightly from existing descriptions and will be described later.

CAPRELLA sp.

Ilfracombe on *Plumularia cristata* (= *Aglaeophenia pluma*) (Gosse, 1853, p. 379). This record probably belongs to one of the three species named above.

Order Schizopoda**GASTROSACCUS SPINIFER** (Goës)

Oldbury, 20.5.1939, in shrimp kypes, rare: Stolford, 9.6.1939, in shrimp nets, rare: Cardiff Roads, common once in plankton in December, 1936, rare from January to April, 1937, absent May to November (Rees, 1939).

PRAUNUS FLEXUOSUS (Müller)

In shrimp kypes and nets. Oldbury, 11.3.1939 and 20.5.1939, fairly common: Stolford, 9.6.1939, a few; 19.6.1939, none; 8.10.1939, present: Portishead, common in Dock, 1936 (Purchon, 1937) and 19.8.1939.

SCHYSTOMYSIS SPIRITUS Norman

A few in Stolford shrimp nets, 9.6.1939: one taken in hand net L.W.M. Portishead, 19.8.1939: rare in plankton of Cardiff Roads and absent in winter (Rees, 1939).

SCYSTOMYSIS ORNATA (G. O. Sars)

One netted at L.W.M. Kilve, 21.5.1939: two in plankton of Cardiff Roads, January, 1937 (Rees, 1939).

MESOPODOPSIS (MACROPSIS) SLABBERI (van Beneden)

A few in Stolford shrimp nets, 9.6.1939: a few netted at L.W.M. Kilve, 21.5.1939: one netted at Portishead, 17.8.1921 (Matthews, 1923): fairly common, April to August, 1937, and absent September, 1936 to March, 1937, in the plankton of Cardiff Roads (Rees, 1939).

NEOMYSIS INTEGER (Leach) (= *N. vulgaris*)

Abundant in summer from Stolford up to above Arlingham Passage: not common in winter from Kilve to Sheperdine (low water records): much commoner than *Praunus flexuosus*: less common than *P. flexuosus* in Portishead Dock, 29.3.1939: one only in surface plankton of Cardiff Roads (Rees, 1939).

Order Euphausiacea**MEGANYCTIPHANES NORVEGICA** (M. Sars)

In shrimp nets. Stolford, 7.7.1939, one; 19.7.1939, one: Burnham, 17.10.1939, four.

Order Decapoda**PASIPHAE SIVADO** Risso

Abundant during the summer in shrimp nets at Stolford: present up to Berkeley in kypes, 1939 and 1940: frequent in winter at Portishead (Matthews, 1923): two in surface plankton of Cardiff Roads, July, 1937 (Rees, 1939): also recorded from Bridgwater and Clevedon (Stebbing, 1906b). An investigation of the bionomics of this interesting deep sea prawn is being made by A. J. Lloyd.

PANDALUS MONTAGUI Leach

In Stolford nets, 18.8.1939, rare; 13.9.1939, common; 11.10.1939, abundant: in Weston nets, 17.12.1938, common: in Oldbury kypes, 19.10.1939, one (an unusual record): Portishead, occasionally stranded (Purchon, 1937): common (Matthews, 1923): rare in the plankton of Cardiff Roads (Rees, 1939): Clevedon (Stebbing, 1906b): common, North and South coasts of Devon and Cornwall (Norman and Scott, 1906, p. 19 as *P. annulicornis*).

PROCESSA CANALICULATA Leach

Stolford nets, 11.10.1939, one.

LEANDER SERRATUS (Pennant)

In Weston nets, spring 1939: in Oldbury kypes, 1938: in Stolford nets, 1939 (carrying eggs in May, June and July, ceased in August): coasts of Somerset (Stebbing, 1906b): common (Norman and Scott, 1906, p. 20).

LEANDER SQUILLA (L.)

Berkeley, August, 1938, a few in kypes: Burnham, 10.3.1940, one in nets: "Among drift weeds in deep pool at H.W.M. near Sharpness. In berry" (Jones, 1865 as *Palaemon squilla*).

LEANDER LONGIROSTRIS (Milne-Edwards)

Berkeley, August, 1937, three in kypes: Sheperdine, 21.8.1939, one in fresh water pool behind embankment (taken by G. A. Walton).

LEANDER ADSPERSUS

Oldbury kypes, November, 1938, and 25.6.1940, rare.

PALAEEMONETES VARIANS (Leach)

At Clevedon above H.W.M. and in fresh water streams (Stebbing, 1906b): in Portishead Dock (Purchon, 1937): Sheperdine, 21.8.1939, several in a freshwater pool behind the embankment (taken by G. A. Walton).

CRANGON VULGARIS L.

Recorded in the plankton of Cardiff Roads (Rees, 1939), at Portishead by Matthews (1923), along the coasts of Somerset (Stebbing, 1906b), at Sharpness (Jones, 1865) and by Smyth (1639). This species is fished commercially from Stolford to Berkeley. Hose nets, swing nets and basketwork kypes are described and figured in Matthews (1933) and Davies (1936). The bionomics of the species have been investigated by A. J. Lloyd (1941b). The fisheries are very old and the kypes primitive.

PALINURUS VULGARIS Latreille

Abundant on Devon and Cornish coasts (Norman and Scott, 1906, p. 13).

HOMARUS VULGARIS Milne-Edwards

Common (Norman and Scott, 1906, p. 13): probably on the coasts of Somerset (Stebbing, 1906b).

GALATHEA SQUAMIFERA Leach

Common at low tide at the end of Brean Down (Matthews, 1923).

EUPAGURUS BERNHARDUS (L.)

Portishead, two at L.W.M. (Purchon, 1937): Weston, 22.4.1939, a few at L.W.S.T.; 20.11.1939, one taken from long line (they attack the tail end of hooked fish); February, 1940, frequent (Ebling, 1940): "Frequent at L.W.M. at the end of Brean Down" (Matthews, 1923): Kilve, 7.5.1939, one at L.W.M.; 21.5.1939, a few: Blue Anchor (East), 23.4.1940, common in slurry on rock at L.W.S.T.

PORTUNUS PUBER (L.)

Several specimens in Portishead Dock in the summer of 1921 (Matthews, 1923): common along the whole coast (Norman and Scott, 1906, p. 2).

PORTUNUS MARMOREUS Leach

In Stolford nets, 20.6.1939, one; July, 1939, a few; 15.11.1939, a few; 8.5.1940, one.

PORTUNUS HOLSATUS Fabricius

In shrimp nets or kypes. Oldbury, summer 1938 and 1939: Weston, any time of year: Stolford, 18.8.1939, 3.5.1940 and 5.6.1940, rare; 15.11.1939, absent: Kilve, 21.5.1939, several minute specimens were netted at L.W.M.

POLYBIUS HENSLOWI Leach

Off North Coast of Devon in herring net (Norman and Scott, 1906, p. 2).

CARCINUS MAENAS (Pennant)

Common up to Portishead; small specimens common up to Sheperdine: recorded "all along the coast" (Matthews, 1923), from Portishead Beach and Dock (Purchon, 1937), from Steepholm (Yonge and Lloyd, 1938), and as 'abundant everywhere' (Norman and Scott, 1906, p. 3). Zoea in plankton of Cardiff Roads, July to September (Rees, 1939).

CANCER PAGURUS L.

Occasional small specimens up to Weston.

PILUMNUS HIRTELLUS (L.)

All along the coasts (Norman and Scott, 1906, p. 4).

INACHUS DORSETTENSIS (Pennant)

Common all along the coasts (Norman and Scott, 1906, p. 7).

MACROPODIA LONGIROSTRIS (Fabricius)

Generally distributed along the coast (Norman and Scott, 1906, p. 7).

Megalopa

Five of these larvae were present in the plankton of Cardiff Roads in August, 1937 (Rees, 1939) and late megalopas were netted at L.W.M. at Kilve, 18.8.1939.

Protozoa

Cardiff Roads plankton, March, 1937, two (Rees, 1939).

ARACHNIDA

Little attention has been paid to the arachnids found on or near the shore. The available records are given here.

Sub-Class ARANEAE

SALTICUS SCENICUS L.

The zebra jumping spider was seen on rocks above H.W.M. near the Old Pier, Weston (19.4.1939) in an area also occupied by *Petrobius*.

Sub-Class ACARI

GAMASELLUS INERMIS

Portishead, occasional at H.W.M. (Purchon, 1937).

RHYNCHOLOPUS NORVEGICUS

Portishead, on mud and stones (Purchon, 1937).

RHYNCHOLOPUS TARDUS

Portishead, occasional under stones (Purchon, 1937).

Sub-Class PYCNOGONIDA

PYCNOGONUM LITTORALE (Stroem)

Blue Anchor (East), 23.4.1940, two on *Tubularia indivisa* at L.W.S.T.

NYMPHON sp.

Weston. To be determined later.

PHOXICHILUS sp.

Ilfracombe (Gosse, 1853, p. 171).

INSECTA

Group APTERYGOTA

PETROBIUS MARITIMUS Leach

Ilfracombe, abundant (Gosse, 1853, p. 390).

PETROBIUS CARPENTERI (Bagn.)

Weston-super-Mare to Kewstoke on cliffs (Womersley, 1923, p. 29). This appears to be the common rock jumper of the Bristol Channel. It is more widely distributed than *P. maritimus*, reaching almost to Bristol on the Somerset side of the Avon. Search for it higher up than the mouth of the Avon has so far been negative (Womersley, 1924, p. 167). Since Womersley does not record *P. maritimus* nearer than Newquay (*loc. cit.*, p. 167), it seems probable that the specimens taken in 1939 at Kilve, Weston and Portishead belong to *P. carpenteri*.

LIPURA MARITIMA Guerin

Portishead, abundant above H.W.N. (Purchon, 1937).

ISOTOMA MARITIMA (Tullberg)

Portishead, among debris on shore (Womersley, 1924, p. 169).

ARCHISOTOMA BESSELSI (Pack)

Weston, 25.3.1923, common under stones between H.W.M. and L.W.M.: Sand Point (near Weston), 5.7.1924, abundant (Womersley, 1924, p. 169).

HYPOGASTRURA STRENUUS (Brown)

Kewstoke and Avon Gorge, above H.W.M. (Womersley, 1925, p. 218).

Various colonies of *Collembola* have been seen in different parts of the estuary but have not been collected.

Group **ENDOPTERYGOTA****CORIXA** sp.

A few taken at Epney, 18.4.1939 and 8.3.1940, and at Ashleworth Ferry, Gloucester West, Bishop's Norton and Wier Green, 8.3.1940.

GERRIS sp.

One in high tide pool (Purchon, 1937).

Ephemerid larvae

A few, Gloucester West, 8.3.1940.

TRICHOPTERA

Haw Bridge, 8.3.1940, one imago: Sheperdine, 21.8.1939, larvae in a salt marsh pool with a small beetle and *Eurydice pulchra*; the salinity of the pool was 22 parts per thousand; on 14.3.1940 the caddis larvae were again present and the salinity was 8 parts per thousand; *Eurydice* was absent.

DIPTERA

Tipulid and blow fly larvae were stranded from a stream on the sand at Arlingham Passage, 18.4.1939. *Chironomid* larvae have been taken at Gloucester West, Wier Green and Haw Bridge (8.3.1940) and were recorded from Portishead Dock (Purchon, 1937): pupae were present in mud on Portishead Beach (Purchon, 1937). Six dipterous pupae were found under a stone at Sheperdine at about mid tide level, 26.3.1939, and Purchon (1937) records a *Bibionid* pupa from Portishead. Larvae and adults, probably of *Coelopa frigida*, were taken at H.W. at Portishead (Purchon, 1937). *Culex* larvae and pupae have been taken in salt marsh pools at Severn Beach,

Oldbury and Sheperdine ; determined salinities were 8, 15 and 22 parts per thousand.

COLEOPTERA

Staphylinid larvae and adults were taken in detritus at H.W.M. Portishead (Purchon, 1937). Jones (1865) records Bembiid beetles in mud cracks near H.W.M. at Sharpness, and beetles were taken with *Orchestia* at Tites Point, Purton, 18.4.1939. Aquatic beetles have been recorded from a salt marsh pool at Sheperdine, 21.8.1939, and (probably fresh water species) from Epney (two species, 18.4.1939) and Wier Green (8.3.1940). Other definite records are :—

AEPUS MARITIMUS Ström

Two under stones at M.T.L. Blue Anchor (East), 24.4.1940 (determined by J. Sankey).

DICHIROSTRICHUS PUBESCENS Payk

Avon Gorge (South side), 9.11.1939, one, above H.W.M. (collected and determined by J. Sankey).

CALLISTUS MOLLIS

Burnham 18.11.1939, under driftwood at H.W.M. near sand dunes (collected and determined by J. Sankey).

EURYNEBRIA COMPLANATA L.

Some forty specimens of this very locally distributed beetle were obtained from under logs above H.W.M. near the sand dunes at Burnham 13.6.1939. Collected by M. E. F. Jones and identified by H. Tetley.

Phylum MOLLUSCA

The names used in this phylum are those given by Winckworth (1932) and White (1938).

PLACOPHORA

LEPIDOCHITONA CINEREUS (L.)

In 1939 and early 1940 this species was common below M.T.L. at Blue Anchor, Kilve, Stolford and Steepholm, occasional at Weston and Portishead, absent, except in the gully, at Aust and only one was taken at Sheperdine. In 1936, however, it was recorded as abundant at Portishead (Purchon, 1937) and Matthews (1923) recorded it as "very common . . . all along the coast." As *Craspedochilus onyx* Spengler, the species is recorded as "generally distributed in 15 to 20 fathoms, and especially on muddy gravel" (Todd, 1906).

ACANTHOCHITONA CRINITUS (Pennant)

General on rocky shores in crevices and empty barnacles and in dredgings inshore (Todd, 1906).

GASTROPODA**Sub-Class PROSOBRANCHIA****Order Archaeogastropoda****DIODORA APERTURA** (Montagu)

Clevedon (Swanton, 1912, p. 73 as *Fissurella graeca*).

PATELLA VULGATA L.

Common from Blue Anchor to Portishead and on Steephholm. (The variety or species *athletica* is recorded from Steephholm (Yonge and Lloyd, 1938), Weston (Ebling, 1940), Kilve and Blue Anchor (1940)). It has been recorded from Ilfracombe, with 'homes' $\frac{1}{8}$ -inch deep (Gosse, 1853, p. 276), Weston, Burnham and Clevedon (Swanton, 1912, p. 72), Portishead (Purchon, 1937), "on all rocky parts of the coast" (Matthews, 1923) and "generally distributed on rocks between tide marks . . . including var. *elevata*, North Devon" (Todd, 1906).

PATINA PELLUCIDA (L.)

Generally distributed (Todd, 1906).

CALLIOSTOMA ZIZYPHINUM (L.)

Generally distributed (Todd, 1906): Clevedon (Swanton, 1912, p. 73).

GIBBULA CINERARIA (L.)

Generally distributed (Todd, 1906): Ilfracombe (Gosse, 1853, p. 119): Weston (Swanton, 1912, p. 73): Blue Anchor (West), 23.4.1940, common.

GIBBULA UMBILICALIS (da Costa)

Generally distributed (Todd, 1906): Burnham (Swanton, 1912, p. 73): Blue Anchor (West), 23.4.1940, a few.

TRICOLIA PULLUS (L.)

Generally distributed L.W. to 10 fathoms (Todd, 1906 as *Phasianella*).

Order Mesogastropoda**THEODOXUS FLUVIATILIS** (L.)

Ashleworth Ferry, 22.8.1939, one.

LACUNA PARVA (da Costa)

On small sea weeds L.W.M. Clevedon (Swanton, 1912, p. 73).

LITTORINA LITTOREA (L.)

Common at Blue Anchor and Kilve, frequent at Weston, sparse on Steephholm (Yonge and Lloyd, 1938) and absent elsewhere although it was recorded as fairly common at Portishead by Matthews (1923) but not by Purchon (1937) and from Sharpness ("a few" Jones, 1865): Swanton (1912, p. 74) records the species from Weston, and Gosse (1853, p. 267) from Ilfracombe. It is "gathered in many places for food, and also to put on mussel beds to keep down *Ulva*" (Todd, 1906).

LITTORINA (*LITTORIVAGA*) *SAXATILIS* L.

This is our commonest gasteropod. It is common or abundant in suitable places from Blue Anchor to Sheperdine, rare at Sharpness and absent above Sharpness (1939). It has been recorded as "generally distributed," (Todd, 1906), "very common . . . on all suitable parts of the coast" (Matthews, 1923), abundant on the beach and in the Dock at Portishead (Purchon, 1937), "common near H.W.M." on Steephholm (Yonge and Lloyd, 1938) and from Weston and Minehead (Swanton, 1912, p. 74).

LITTORINA (*MELARHAPHE*) *NERITOIDES* L.

Generally distributed and common (Todd, 1906): between Burnham and Brean, Minehead (Swanton, 1912, p. 74).

LITTORINA (*NERITOIDES*) *LITTORALIS* (L.)

Blue Anchor, 22.4.1940, common: Weston, 22.4.1939, 17.8.1939, February, 1940, fairly common: Portishead, 19.8.1939, 11.3.1940, rare; fairly common (Matthews, 1923); abundant (Purchon, 1937): Steephholm, July, 1938, common (Yonge and Lloyd, 1938): Aust, 19.3.1939 and 9.3.1940, frequent: Sheperdine, 26.3.1939, frequent; 21.8.1939 and 14.3.1940, absent: generally distributed (Todd, 1906): Weston, Burnham, Minehead (Swanton, 1912, p. 73): egg masses recorded in April (Weston and Blue Anchor) and July (Steephholm).

HYDROBIA VENTROSA (Montagu)

"Brackish. Avonmouth, Shirehampton and Cook's Folly. Ditch near the Pill at Clevedon, Weston" (Swanton, 1912, p. 55).

POTAMOPYRGUS JENKENSII (Smith)

Not recorded from the estuary itself. Very common in streams running in at Kilve, Elmore Back and Epney (1939). Not recorded by Swanton (1912).

HYDROBIA (*PERINGIA*) *ULVAE* (Pennant)

Kilve, 21.5.1939, rare: Weston, 22.4.1939, abundant near the New Pier, common on Birnbeck Island: Portishead, occasional

(Purchon, 1937): Aust (Old Jetty), 16.8.1939, common; 19.3.1939, occasional: Sheperdine, 26.3.1939 and 21.8.1939, rare: Sharpness, 24.8.1939, one dead shell: "Common in brackish water of estuaries on mud, *Zostera* and under stones" (Todd, 1906): Weston. River mouths on Somerset coast (Swanton, 1912, p. 74 as *Paludestrina stagnalis*).

BITHYNIA TENTACULATA (L.)

Ashleworth Ferry, 22.8.1939, one large, three small: generally distributed in ditches, streams and sluggish rivers (Swanton, 1912, p. 55).

CINGULA (ONOA) SEMICOSTATA (Montagu)

Generally distributed, L.W. to 10 fathoms (Todd, 1906): Weston (Swanton, 1912, p. 74): as *Onoba striata*.

ALVANIA (MANZONIA) CRASSA (Kanmacher)

Generally distributed but not common (Todd, 1906 as *M. costata*).

RISSOA (RISSOA) MEMBRANACEA (Adams)

Generally distributed (Todd, 1906).

RISSOA (TURBOELLA) PARVA (da Costa)

Generally distributed (Todd, 1906): Minehead (Swanton, 1912, p. 74).

OMALOGYRA ATOMUS (Philippi)

Weston (Swanton, 1912, p. 75 as *Homalogyra*).

TURRITELLA COMMUNIS Risso

Weston (Swanton, 1912, p. 76).

CAECUM IMPERFORATUM (Kanmacher)

Devon, coralline zone, fairly common (Todd, 1906).

BITTIUM RETICULATUM (da Costa)

Clevedon (Swanton, 1912, p. 75).

CERITHIOPSIS TUBERCULARIS (Montagu)

Clevedon and Minehead (Swanton, 1912, p. 75).

CLATHRUS CLATHRUS (L.)

Occasional on North coast (Todd, 1906): Clevedon (Swanton, 1912, p. 76): as *Scala*.

EULIMA TRIFASCIATA (Adams)

Generally distributed (Todd, 1906 as *Cingula*).

BALCIS ALBA (da Costa)

Weston and about Burnham (Swanton, 1912, p. 76 as *Eulima polita*).

ODOSTOMIA (JORDANIELLA) NIVOSA (Montagu)

Ilfracombe (Todd, 1906 as *Jordanula*).

ODOSTOMIA (ODOSTOMIA) PLICATA (Montagu)

Clevedon (Swanton, 1912, p. 76).

ODOSTOMIA (ODOSTOMIA) TURRITA Hanley

var. *striolata*, Ilfracombe (Todd, 1906).

ODOSTOMIA (ODOSTOMIA) UNIDENTATA (Montagu)

Minehead (Swanton, 1912, p. 76).

ODOSTOMIA (BRACHYSTOMIA) SCALARIS Macgillivray

Very common among dwarf mussels and rocks at L.W. (Todd, 1906).

TURBONILLA ELEGANTISSIMA (Montagu)

Birnebeck Cove, Weston (Swanton, 1912, p. 76 as *T. lactea*).

TURBONILLA INNOVATA Monterosato

Ilfracombe (Todd, 1906 as *T. pusilla*).

APORRHAIUS PESPELECANI (L.)

Fairly common 5 to 35 fathoms (Todd, 1906).

NATICA (LUNATIA) CATENA (da Costa)

Near Burnham (Swanton, 1912, p. 75).

NATICA (LUNATIA) POLIANA Chiaje

Generally distributed L.W. to 35 fathoms (Todd, 1906).

NATICA (LUNATIA) MONTAGUI Forbes

Devonshire, 30 to 35 fathoms (Todd, 1906).

VELUTINA VELUTINA (Müller)

Minehead (Swanton, 1912, p. 75 as *V. laevigata*).

LAMELLARIA PERSPICUA (L.)

Minehead (Swanton, 1912, p. 75).

TRIVIA MONACHA

Generally distributed (Todd, 1906) and rare, Weston (Swanton, 1912, p. 75) as *T. europaea*.

Order Stenoglossa**TROPHON (TROPHONOPSIS) MURICATUS** (Montagu)

Occasional 15 to 30 fathoms (Todd, 1906).

NUCELLA LAPILLUS (L.)

Blue Anchor, 23.4.1940, abundant at L.W.S.T., particularly at the west end although there was no food material there: Kilve,

7.5.1939, not common at L.W.M.; 10.3.1940, abundant: Weston, 22.4.1939, abundant at L.W.S.T., one lot of eggs just being laid; February 1940, common (Ebling, 1940): Brean Down, plentiful (Matthews, 1923 as *Purpura*): Weston, Burnham, Clevedon and Minehead; var. *elongata* (Wood) from Burnham (Swanton, 1912, p. 77 as *Purpura*): common everywhere (Todd, 1906).

OCENEBRA ERINACEA (L.)

Blue Anchor (East), 23.4.1940, one: Weston, Burnham, Clevedon (Swanton, 1912, p. 76): generally distributed, common only in places, (Todd, 1906).

BUCCINUM UNDATUM L.

Blue Anchor (West), 23.4.1940, dead shells common at L.W.S.T.; an undersized egg cluster (hatching) was also taken: Weston, common L.W.E.S.T. (Ebling, 1940): Brean Down, several at L.W.S.T. (Matthews, 1923): Steephelm, dead shells only, although Matthews says living specimens occur at L.W.S.T. (Yonge and Lloyd, 1938): Weston, Burnham, Minehead (Swanton, 1912, p. 76): fairly common everywhere (Todd, 1906).

CHAUVETIA BRUNNEA (Donovan)

Fairly common, L.W. to 20 fathoms (Todd, 1906, as *Donavania minima*).

NASSARIUS (HIMA) RETICULATUS (L.)

Blue Anchor (East), 23.4.1940, one dead: Weston, Burnham, Clevedon, etc. (Swanton, 1912, p. 77): "fairly common everywhere" (Todd, 1906): as *Nassa*.

NASSARIUS (HIMA) INCRASSATUS (Ström)

Fairly common everywhere (Todd, 1906).

HAEDROPLEURA SEPTANGULARIS (Montagu)

Clevedon (Swanton, 1912, p. 77 as *H. costata*).

LORA TURRICULA (Montagu)

Weston (Swanton, 1912, p. 77 as *Bela*).

LORA RUFA (Montagu)

Weston, Clevedon (Swanton, 1912, p. 77 as *Bela*).

MANGELIA ATTENUATA (Montagu)

Occasional (Todd, 1906).

PHILBERTIA (COMARMONDIA) GRACILIS (Montagu)

Weston (Swanton, 1912, p. 77 as *Mangilia*).

Sub-Class OPISTHOBRANCHIA

Order Pleurocoela

DIAPHANA MINUTA Brown

Devon (Todd, 1906 as *D. hyalina* from Forbes and Hanley, 1848, III, p. 521 as *Amphisphyra hyalina*).

RETUSA RETUSA (Maton and Rackett)

Clevedon (Swanton, 1912, p. 77 as *Tornatina truncatula*).

RETUSA ALBA (Kanmacher)

Frequent in muddy estuaries and brackish waters; Weston, Burnham, Clevedon (Swanton, 1912, p. 77 as *Tornatina obtusa*).

CYLICHNA CYLINDRACEA (Pennant)

Weston (Swanton, 1912, p. 78 as *Bullinella*).

TRICLA LIGNARIA (L.)

Weston (Swanton, 1912, p. 78 as *Scaphander lignarius*).

PHILINE APERTA (L.)

"attains its largest dimensions in the Bristol Channel" (Swanton, 1912, p. 78).

HERMANIA SCABRA (Müller)

Devon (Forbes and Hanley, 1848, III, p. 543 as *Philine*).

TETHYS PUNCTATA (Cuvier)

Very common occasionally (Todd, 1906).

Order Acoela

ACANTHODORIS PILOSA (Abildgaard)

Blue Anchor (East), 23.4.1940, one below M.T.L.: Kilve, 7.5.1939, one; 21.5.1939, one.

ONCHIDORIS MURICATA (Müller)

Blue Anchor, 22.4.1940 (East) a few with spawn, (West) spawn only: Kilve, 10.3.1940, three at L.W.M.: Weston, 22.4.1939, common with spawn at L.W.S.T.; February and March, 1940, common (Ebling, 1940).

OKENIA ELEGANS (Leuckart)

Devon (Todd, 1906 as *Idalina elegans* and *Idaliella quadricornis*).

ARCHIDORIS BRITANNICA (Johnston)

Fairly common (Todd, 1906 as *A. tuberculata*).

DENDRONOTUS FRONDOSUS (Ascanius)

Generally distributed, not common (Todd, 1906).

JANOLUS CRISTATUS (Chiaje)

Ilfracombe (Gosse, 1853, p. 325 as *Antiopa*).

IDULIA FRAGILIS (Forbes)

Common (Todd, 1906 as *Doto*).

AEOLIDIA PAPILLOSA (L.)

Fairly common (Todd, 1906 as *Eolis*).

An *Eolis*-of the *gracilis* type was found among preserved *Tubularia* from Blue Anchor (East) 23.4.1940.

Sub-Class **PULMONATA**Order **Basommatophora****LEUCOPEPLA BIDENTATA** (Montagu)

Banks of Avon near Pill—also var. *alba* Turton (Swanton, 1912 p. 78 as *Leuconia*).

PHYTIA MYOSOTIS (Draparnaud)

Abundant in the Avon Gorge, often associated with *Sphaeroma rugicauda* 12.11.1939 (J. Sankey): banks of Avon near Pill, also var. *myosotis* Draparnaud (Swanton, 1912, p. 78 as *Alexia denticulata*).

LIMNAEA PEREGER (Müller)

Epney, 18.4.1939, one: Ashleworth Ferry, 22.8.1939, six small ones.

Order **Stylommatophora****SUCCINEA PFEIFFERI** (Rossmassler)

Gloucester (West), 8.3.1940, one small one.

Gastropod larvae

Present in plankton of Cardiff Roads, March to September (Rees, 1939).

SCAPHOPODA**DENTALIUM VULGARE** (da Costa)

Weston (Swanton, 1912, p. 72).

LAMELLIBRANCHIA

PROTOBRANCHIA

NUCULA NUCLEUS (L.)

Blue Anchor (East), 22.4.1940, common in mud below M.T.L. (identified by C. M. Yonge): Weston and Burnham, frequent, and Clevedon (Swanton, 1912, p. 66).

FILIBRANCHIA

GLYCIMERIS GLYCIMERIS (L.)

Between Brean and Burnham; not common on the Somerset coast (Swanton, 1912, p. 66).

ARCA (NAVICULA) TETRAGONA Poli

Occasional (Todd, 1906).

ARCA (BARBATIA) LACTEA L.

Ilfracombe (deep water) (Todd, 1906).

ANOMIA EPHIPPIMUM L.

Blue Anchor (West), 23.4.1940, a few: Weston, Burnham and Minehead (Swanton, 1912, p. 66): fairly common everywhere (Todd, 1906).

MONIA PATELLIFORMIS (L.)

Generally distributed below 10 fathoms (Todd, 1906 as *Anomia*).

MYTILUS EDULIS L.

Blue Anchor (West), 23.4.1940, widespread but small at about M.T.L.: occasional small specimens have been taken near L.W.M. at Blue Anchor (East), Kilve, Portishead and Aust: Swanton (1912, p. 66) records it from Weston and Burnham.

MODIOLUS BARBATUS (L.)

Minehead, uncommon; occasionally washed ashore between Brean and Burnham (Swanton, 1912, p. 67).

MUSCULUS DISCORS (L.)

Common all round our shores (Forbes and Hanley, 1853, II, p. 195 as *Crenella*): Kilve, 10.3.1940, one.

MUSCULUS MARMORATUS (Forbes)

Generally distributed in the tests of Ascidians (Todd, 1906 as *Modiolaria*).

PSEUDOLAMELLIBRANCHIA

OSTREA EDULIS L.

Blue Anchor (West), 23.4.1940, dead shells: Swanton (1912, p. 67) records dead shells as common on the Somerset coast. There used to be productive oyster beds in Blue Anchor Bay (Hewitt, 1906, p. 401).

PINNA (ATRINA) FRAGILIS Pennant

Birnbeck Cove, Weston, one dead (Swanton, 1912, p. 67).

PECTEN MAXIMUS (L.)

Generally distributed (Todd, 1906): coast between Brean and Berrow, rare (Swanton, 1912, p. 67).

CHLAMYS VARIA (L.)

Minehead and Weston, not common; the varieties *nivea* and *purpurea* also recorded (Swanton, 1912, p. 67 as *Pecten*).

CHLAMYS DISTORTA (da Costa)

Fairly common (Todd, 1906 as *Hinnites pusio*): Brean Down, an odd valve (Swanton, 1912, p. 67).

CHLAMYS (AEQUIPECTEN) OPERCULARIS (L.)

Burnham, Minehead, Weston, uncommon (Swanton, 1912, p. 68 as *Pecten*).

TELEODESMACEA**ASTARTE SULCATA (da Costa)**

Birnbeck Cove, Weston, a worn shell (Swanton, 1912, p. 68).

THYASIRA FLEXUOSA (Montagu)

Coasts about Burnham and Weston (Swanton, 1912, p. 68).

LORIPES LUCINALIS L

Weston, Burnham (Swanton, 1912, p. 68 as *L. lacteus*).

PHACOIDES (LUCINOMA) BOREALIS (L.)

Burnham, uncommon (Swanton, 1912, p. 68 as *Lucina*).

KELLIA SUBORBICULARIS (Montagu)

Fairly common (Todd, 1906).

LASAEA RUBRA (Montagu)

Abundant (Todd, 1906): Birnbeck Cove, Weston (Swanton, 1912, p. 69).

CYPRINA ISLANDICA (L.)

About Brean and Burnham (Swanton, 1912, p. 68).

CARDIUM (ACANTHOCARDIA) ECHINATUM L.

About Burnham and Minehead (Swanton, 1912, p. 71).

CARDIUM (CERASTODERMA) EDULE L.

Weston, February, 1940, dead shells only (Ebling, 1940): Weston, Berrow Sands, Burnham, Minehead, etc. (Swanton, 1912, p. 71): the variety *lamarcki* (= *rusticum*) is common in Portishead Dock (Matthews, 1923 and Purchon, 1937) and has been studied by Purchon (1939).

DOSINIA LUPINUS (L.)

About Burnham, rare (Swanton, 1912, p. 70).

VENUS (CHAMELEA) STRIATULA (da Costa)

Between Brean and Burnham, rare (Swanton, 1912, p. 70 as *V. gallina*).

PAPHIA (VENERUPIS) RHOMBOIDES (Pennant)

Burnham, Weston (Swanton, 1912, p. 70 as *Tapes virgineus*).

PAPHIA (VENERUPIS) PULLASTRA (Montagu)

Generally distributed on shore and in dredgings in estuaries (Todd, 1906 as *Tapes*).

PAPHIA (VENERUPIS) SAXATILIS (Fleuriau)

Common in *Pholas* and *Saxicava* (= *Hiatella*) borings (Todd, 1906 as *Tapes pullastra* var. *perforans*).

IRUS IRUS (L.)

Plymouth and other parts of Devonshire (Todd, 1906).

MYSIA UNDATA (Pennant)

About Burnham, rare (Swanton, 1912, p. 70 as *Lucinopsis*).

TELLINA TENUIS da Costa

Abundant in many parts, about Burnham and Berrow Flats, Weston (Swanton, 1912, p. 69).

TELLINA (ARCOPAGIA) CRASSA Pennant

Between Brean and Berrow (Swanton, 1912, p. 69): Sharpness L.W.M. (Jones, 1865).

MACOMA BALTHICA (L.)

Common in muddy sand near M.T.L. at Weston and Blue Anchor: rare at Portishead: abundant in stiff mud at Aust and Sheperdine: two at L.W.M. Sharpness: "One of our commonest shells about Weston and between Brean and Burnham" (Swanton, 1912, p. 69).

SCROBICULARIA PLANA (da Costa)

Common in mud and muddy gravel in estuaries (Todd, 1906): frequent at L.W.M. in mud and clay, Weston (Swanton, 1912, p. 69): dead shells Aust and Sheperdine, 1939.

ABRA ALBA (WOOD)

Weston (Swanton, 1912, p. 69): Sharpness, a few at L.W.M. (Jones, 1865): as *Syndosmya*.

GARI (PSAMMOCOLA) DEPRESSA (Pennant)

Weston, uncommon (Swanton, 1912, p. 71).

ENSIS ENSIS (L.)

Generally distributed (Todd, 1906): a few valves near Burnham (Swanton, 1912, p. 71).

ENSIS SILIQUA (L.)

About Burnham and Weston (Swanton, 1912, p. 71).

SPISULA SOLIDA (L.)

Common generally in sandy estuaries and bays (Todd, 1906): Weston, uncommon (Swanton, 1912, p. 70).

LUTRARIA LUTRARIA (L.)

Weston and the coast between Brean and Burnham (Swanton, 1912, p. 70 as *L. elliptica*): Portishead, occasional, small (Purchon, 1937).

MYA (ARENOMYA) ARENARIA L.

Portishead Dock (Purchon, 1937).

ALOIDIS GIBBA (Olivi)

About Burnham and Weston (Swanton, 1912, p. 71 as *Corbula*).

HIATELLA ARCTICA (L.)

Generally distributed (Todd, 1906): Clevedon and Minehead (Swanton, 1912, p. 71 as *Saxicava rugosa*).

PHOLAS DACTYLUS L.

Dead shells abundant in rock borings at Kilve, 18.8.1939, and Blue Anchor (East), 23.4.1940: Clevedon (Swanton, 1912, p. 72).

BARNEA CANDIDA L.

Dead shells in rock borings, Kilve, 7.5.1939, and Blue Anchor (East), 23.4.1940: Weston (Swanton, 1912, p. 72).

BARNEA (ANCHOMASA) PARVA (Pennant)

Kilve, 7.5.1939, dead shells and one living specimen in rock borings: Blue Anchor (East), 23.4.1940, abundant dead shells in borings.

TEREDO MEGOTARA Forbes and Hanley

Not infrequently washed ashore in fir, Somerset (Swanton, 1912, p. 72).

LAMELLIBRANCH LARVAE

Cardiff Roads plankton, 1936-7, common September to May with a peak in December and March, absent June to August (Rees, 1939).

CEPHALOPODA**Order Decembrachiata****LOLIGO FORBESI Steenstrup**

Occasional everywhere (Todd, 1906): Oldbury, in kype, 1938.

SEPIA OFFICINALIS (L.)

Oldbury kypes, June, 1938, one; May, 1939, one, large: Stolford nets, 5.6.1940, four: Weston, 8.5.1940, shell; also taken in shrimp

nets (Ebling, 1940): "Generally distributed and fairly common. Comes into bays and estuaries to spawn, July, August." (Todd, 1906): "Cuttle fish" are recorded from the Weston nets by Knight (1902) and by Smyth (1639).

SEPIOLA (HETEROSEPIOLA) ATLANTICA (Orbigny)

Oldbury kypes, 23.1.1938 and September, 1938, rare: Stolford nets, May, 1939, more common: Burnham nets, summer 1939, occasional: "Fairly common in bays and estuaries" (Todd, 1906).

Phylum POLYZOA

ECTOPROCTA

Order Gymnolaemata

AETEA ANGUINA (L.)

Ilfracombe, June and August, 1852, common near L.W.M. on *Delesseria hypoglossum* at Hele, on small seaweeds and on *Crisia aculeata* near Capstone Hill and the Tunnels (Gosse, 1853, pp. 142, 144, 205 and 206 as *Anguinaria spatulata*): very abundant in the south and west (Hincks, 1880, p. 4).

AETEA TRUNCATA (Landsborough)

Ilfracombe, between tide marks (Hincks, 1880, p. 8).

SCRUPARIA CHELATA (L.)

Ilfracombe, between tide marks at Hele and Capstone Base (Gosse, 1853, p. 132 and p. 435): the variety *gracilis* from ten fathoms (Hincks, 1880, I, p. 14): as *Euchratea*.

GEMELLARIA LORICATA (L.)

Ilfracombe, off the Capstone 8 to 10 fathoms (Hincks, 1880, p. 18).

SCRUPOCELLARIA REPTANS (L.)

Near Ilfracombe, dead (Gosse, 1853, p. 435).

SCRUPOCELLARIA SCRUPOSA (L.)

Generally distributed (Hincks, 1880, p. 45).

CABEREA BORYI Audouin

Ilfracombe (probably) (Hincks, 1880, p. 61) and definitely as *Cellularia hookeri* from Combe Martin Bay, 1852 (Gosse, 1853, p. 435).

BICELLARIELLA CILIATA (L.)

Kilve, near L.W.M. under stones; 21.5.1939 and 28.5.1939, rare; 18.8.1939, common; 10.3.1940, absent: Ilfracombe, rockpools and dredged from 8 to 10 fathoms (Hincks, 1880, p. 68 as *Bicellaria*).

Tunnel Rocks and Watermouth, Ilfracombe, common (Gosse, 1853, pp. 144 and 435).

BUGULA AVICULARIA (L.)

Ilfracombe, in shallow pools near Capstone Hill (Gosse, 1853, p. 195 as *Cellularia*).

BUGULA TURBINATA Alder

Near L.W.M. Ilfracombe, common (Hincks, 1880, p. 77).

BEANIA MIRABILIS Johnston

Ilfracombe, common on stones in rock pools (Hincks, 1880, p. 96 and Gosse, 1853, p. 205).

FLUSTRA FOLIACEA (L.)

Wildersmouth Beach, near Ilfracombe, dead (Gosse, 1853, p. 435).

FLUSTRA PAPYRACEA Ellis and Solander

Ilfracombe, 16.9.1852, the Tunnels, L.W.E.S.T. (Gosse, 1853, p. 400) : Ilfracombe, 8 to 10 fathoms (Hincks, 1880, p. 118).

MEMBRANIPORA AURITA Hincks

Blue Anchor (East), 22.4.1940, near L.W.M. and on dead *Pholas* shells in borings, much dead, some alive : Kilve, 18.8.1939 and 10.3.1940, common under stones and on *Tubularia* at L.W.M. : Weston, 17.8.1939 and 20.10.1939, widespread and abundant at L.W.S.T. and in a gully at M.T.L. : Aust, 9.3.1940, the commonest species, much dead, some alive ; 16.8.1939, common.

MEMBRANIPORA DUMERILI (Audouin)

Ilfracombe, on *Laminaria* (Hincks, 1880, p. 156).

MEMBRANIPORA LINEATA (L.)

Ilfracombe, on *Laminaria* (Hincks, 1880, p. 143).

MEMBRANIPORA MEMBRANACEA (L.)

Universally distributed and very abundant on *Laminaria*, etc. (Hincks, 1880, p. 140).

MEMBRANIPORA HEXAGONA Busk

Coast of Devon (Hincks, 1880, p. 143).

ELECTRA PILOSA (L.)

Universal and extremely abundant (Hincks, 1880, p. 137) : Ilfracombe, everywhere on algae (Gosse, 1853, p. 435) : as *Membranipora*.

ELECTRA HASTINGSÆ Marcus (= *Membranipora monostachys* Hincks not Busk)

Common near L.W.M. from Blue Anchor to Sheperdine, 1939 : Ilfracombe on the Capstone Rocks (Hincks, 1880, p. 131).

ELECTRA CRUSTULENTA var. **FOSSARIA** (Hincks) (= *Membranipora monostachys* var. *fossaria* Hincks)

Aust, 19.3.1939, 16.8.1939 and 9.3.1940, common near L.W.M.: Sheperdine, 26.3.1939, frequent below M.T.L.: Sharpness, 16.4.1939, a little.

CELLARIA SALICORNIA (Pallas)

Ilfracombe (Hincks, 1880, p. 106 as *C. fistulosa*).

CRIBRILINA PUNCTATA (Hassall)

Ilfracombe (Hincks, 1880, p. 190).

MICROPORELLA IMPRESSA (Audouin)

Ilfracombe, under ledges on the Capstone (Hincks, 1880, p. 214).

LEPRALIA FOLIACEA (Ellis and Solander)

Ilfracombe, deep water off the Capstone (Hincks, 1880, p. 300).

LEPRALIA PALLIASANA (Moll)

Portishead Dock, 6.11.1936, encrusting serpulid tubes on a ship (Purchon, 1937).

UMBONULA VERRUCOSA (Esper)

Ilfracombe, in clefts on the Capstone (Hincks, 1880, p. 317).

CHORIZOPORA BRONGNIARTI (Audouin)

Ilfracombe, on *Laminaria* (Hincks, 1880, p. 224).

PORELLA COMPRESSA (Sowerby)

Devonshire (Hincks, 1880, p. 330).

MUCRONELLA COCCINEA (Abildgaard)

Ilfracombe (Hincks, 1880, p. 371): Ilfracombe, Capstone Base (Gosse, 1853, p. 435 as *Lepralia*). It was probably this species that Gosse watched metamorphosing in June, 1852, at Ilfracombe (*loc. cit.* p. 218).

MUCRONELLA PEACHI (Johnston)

Blue Anchor, 23.4.1940, abundant: Kilve, 18.8.1939 and 10.3.1940, and Weston, 22.4.1939, present: universally distributed (Hincks, 1880 p. 360).

SCHIZOPORELLA LINEARIS (Hassall)

Ilfracombe, 8 to 10 fathoms (Hincks, 1880, p. 247).

SCHIZOPORELLA SPINIFERA (Johnston)

Ilfracombe, on roots of Tangle at the Tunnel, 1852 (Gosse, 1853, p. 435 as *Lepralia*): Ilfracombe (Hincks, 1880, p. 241).

SCHIZOPORELLA UNICORNIS (Johnston)

Ilfracombe (Hincks, 1880, p. 238).

COSTAZIA COSTAZII (Audouin)

Ilfracombe, off the Capstone (Hincks, 1880, p. 411 as *Cellepora*).

CELLEPORA PUMICOSA L.

Generally distributed (Hincks, 1880, p. 398).

CRISIA ACULEATEA Hassall

Ilfracombe, Capstone Hill (Gosse, 1853, p. 205).

CRISIA DENTICULATA Lamarck

Ilfracombe, on algae at Hele, 1852 (Gosse, 1853, p. 435).

CRISIA EBURNEA (L.)

Ilfracombe, Tunnel Rocks and Hele (Gosse, 1853, p. 435).

CRISIDIA CORNUTA (L.)

Ilfracombe, the Tunnels with *Crisia* and at Hele on *Delesseria sanguinea* (Gosse, 1853, pp. 216 and 435): Ilfracombe (Hincks, 1880, p. 419).

CRISIDIA GENICULATA Milne-Edwards

Ilfracombe, on roots of Tangle on Tunnel Rocks (Gosse, 1853, p. 435).

BERENICEA PATINA (Lamarck (= *Diastopora patina*))

Several colonies, L.W.S.T. Blue Anchor (East), 22.4.1940.

TUBILIPORA LILIACEA (Pallas)

Generally distributed (Hincks, 1880, p. 453 as *Idmonea serpens* (L.)).

TUBILIPORA PHALANGEA Couch

Ilfracombe, 21.6.1852, on *Nitophyllum laceratum* in rock pool at Hele (Gosse, 1853, p. 227 as *T. flabellaris*).

STOMATOPORA GRANULATA (Milne-Edwards)

Ilfracombe, at Lee (Hincks, 1880, p. 425).

LICHENOPORA HISPIDA (Fleming)

Ilfracombe (Hincks, 1880, p. 473).

ALCYONIDIUM GELATINOSUM (L.)

A few small colonies near L.W.M. at Blue Anchor (East), 22.4.1940, Kilve, 21.5.1939 and 18.8.1939, and Weston, 22.4.1939 and 17.8.1939: large colonies are occasionally taken in kypes, e.g. Oldbury, 22.4.1939: Ilfracombe (Hincks, 1880, p. 491).

ALCYONIDIUM HIRSUTUM (Fleming)

Ilfracombe and Watchet (Hincks, 1880, p. 493): Ilfracombe, on stem of a red seaweed near L.W.M. at the Tunnel (Gosse, 1853, p. 157 as *Cycloum papillosum*).

ALCYONIDIUM ALBIDUM Alder

Ilfracombe, not uncommon (Hincks, 1880, p. 500).

ALCYONIDIUM POLYOM (Hassall)

Portishead, 16.9.1936, rare on Royal Beach (Purchon, 1937, as *Membranipora hexagonia*).

FLUSTRELLA HISPIDA (Fabricius)

Very common and widely diffused (Hincks, 1880, p. 506) : Ilfracombe, in caverns at Lee, 1852 (Gosse, 1853, p. 435 as *Alcyonidium hispidum*).

VESICULARIA SPINOSA (L.)

Ilfracombe, on weed in rock pools and off the Capstone, 8 to 10 fathoms (Hincks, 1880, p. 513).

AMATHIA LENDIGERA (L.)

Ilfracombe, tide-marks and 8 to 10 fathoms (Hincks, 1880, p. 516).

BOWERBANKIA CITRINA (Hincks)

Ilfracombe, near the Tunnels and dredged off the Capstone (Hincks, 1880, p. 524).

BOWERBANKIA GRACILLIMA (Hincks)

Ilfracombe (Hincks, 1880, p. 525).

BOWERBANKIA CAUDATA (Hincks)

Ilfracombe (Hincks, 1880, p. 522).

BOWERBANKIA IMBRICATA (Adams)

Very common and generally distributed (Hincks, 1880, p. 519) : Ilfracombe, the Tunnels with *Crisia*, Capstone Hill and Wildersmouth (Gosse, 1853, pp. 215, 216 and on p. 436 as *B. densa*) : Portishead, 24.10.1936, abundant on overhanging ledges on Royal Beach at L.W.M. (Purchon, 1937) : Aust, 16.8.1939, reef at L.W.M.

BOWERBANKIA PUSTULOSA (Ellis and Solander)

Ilfracombe, extremely abundant off the Capstone (Hincks, 1880, p. 522) : Morte Point (Gosse, 1853, p. 436).

FARRELLA REPENS (Ferre) var. **ELONGATA** (Hincks)

Blue Anchor (East), 22.4.1940, on dead *Pholas* shells.

NOLELLA DILATATA (Hincks)

Ilfracombe (Hincks, 1880, p. 536 as *Cylindroecium*).

NOLELLA PUSILLA (Hincks)

Ilfracombe, the Capstone (Hincks, 1880, p. 537 as *Cylindroecium*).

ANGUINELLA PALMATA van Beneden

Ilfracombe (Hincks, 1880, p. 539).

VALKERIA UVA (L.)

Ilfracombe (Hincks, 1880, p. 551) : on small algae near Hele (Gosse, 1853, p. 436 as *V. cuscuta*).

VALKERIA TREMULA Hincks

Ilfracombe, not uncommon on the Capstone (Hincks, 1880, p. 554).

ENTOPROCTA**PEDICELLINA CERNUA (Pallas)**

Common and widely distributed (Hincks, 1880, p. 565) : Ilfracombe, on a variety of weeds and other growths at Capstone Hill, the Tunnels, Hele and Smallmouth in Combe Martin Bay (Gosse, 1853, pp. 158, 205, 210, 217 and 436 as *P. belgica* and *P. echinata*).

BARENTSIA GRACILIS (Sars)

Ilfracombe (Hincks, 1880, p. 570) : Ilfracombe, the Tunnels and Capstone on *Crisia* and Corallines (Gosse, 1853, pp. 215 and 436) : as *Pedicellina* : Kilve, 18.8.1939 under stones at L.W.M.

Cyphonautes larvae occurred in the plankton of Cardiff Roads in November, 1936 (Rees, 1939).

Phylum ECHINODERMATA

Many species might be expected to occur at Ilfracombe but few actual records have, as yet, been obtained.

ASTEROIDEA**Order Spinulosa****SOLASTER (CROSSASTER) PAPPOSUS (L.)**

Kilve, 21.5.1939, rare at L.W.S.T., 18.8.1939, common, L.W.S.T.

Order Forcipulata**MARTHASTERIAS GLACIALIS (L.)**

Ilfracombe (Todd, 1906).

Post larval Asteroids

Ten in September, 1936, Cardiff Roads plankton (Rees, 1939).

OPHIUROIDEA**Order Ophiuræ****AMPHIPHOLIS SQUAMATA (Delle Chiaje)**

Blue Anchor (East), 24.4.1940, one at M.T.L.

ECHINOIDEA

Order Diadematoidea

PARACENTROTUS LIVIDUS (Lamarck)

Ilfracombe (Todd, 1906 as *Strongylocentrotus*).

Echinoplutei

Ten in September, 1936, Cardiff Roads plankton (Rees, 1939).

Phylum TUNICATA

Order Ascidiacea

MOLGULA CITRINA Alder and Hancock

Portishead Dock, 1936, frequent (Purchon, 1937).

BOTRYLLUS SCHLOSSERI (Pallas)

Portishead Dock, 1936, abundant (Purchon, 1937 and Matthews, 1923 as *B. violaceus*).

PEROPHORA LISTERI Forbes

Ilfracombe (Gosse, 1853, p. 238 as *Clavellina*).

AMAROUCIUM PROLIFERUM Milne-Edwards

Ilfracombe, tadpoles, probably of this species, in pools at the Capstone (Gosse, 1853, p. 322).

Order Appendicularia

OIKOPLEURA DIOICA Fol

Cardiff Roads plankton, common in September, 1936, June and July, 1937, abundant in August, 1937 (Rees, 1939).

Ascidian larvae

Cardiff Roads plankton, present in September, 1936 and July, 1937, common in June, 1937 (Rees, 1939).

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Studies on the Biology of the Bristol Channel

V

THE MARINE FISH FAUNA OF THE SOUTHERN SHORES OF THE BRISTOL CHANNEL

By A. J. LLOYD, B.Sc.

(*Read in title, March 1, 1941*)

INTRODUCTION

DURING the past three years a survey of the fish fauna has been carried out in the Bristol Channel and Estuary of the Severn. Collections in the Estuary were made particularly at Hayward Rock Salmon Fishery near Berkeley, at Oldbury Salmon Pool near Cowhill, and at the Hallen Fishery (now disused). Personal visits were made regularly to estimate the nature of the catch made by the local fishermen who themselves kept any unusual species which appeared from time to time. The fish are caught in "fixed engines" consisting of funnel-shaped basket-work filters made of withy, the mouth of the funnel facing upstream (for details see Matthews, 1934). The fine mesh of these "putts" retains even the shrimps which form the bulk of the catch during the greater part of the year. Smaller baskets of more open design are used during the season for the capture of salmon.

In the Bristol Channel, nets of various designs again exploit the great tidal range, and large numbers of fish are caught in them. Shrimp nets are staked along the shores at Weston-super-Mare, at Burnham-on-Sea and at Stolford in Bridgwater Bay. At the last named, a large commercial shrimp fishery has been carried on by one family for hundreds of years. At the present time over 150 nets are fished here and much interesting material has been collected. The catch in the peculiar swing nets used at Weston has given some indication of the nature of the fish fauna in the deeper waters offshore.

This investigation has been carried out under the general supervision of Professor C. M. Yonge, while Dr. L. H. Matthews and Mr. R. Bassindale have given much helpful advice. The author is also greatly indebted to the following fishermen without whose assistance

the survey could not have been carried out:—Mr. M. Haines of Berkeley, Mr. R. Knapp of Oldbury-on-Severn, Mr. R. Pullen of Hallen, Messrs. Webb of Weston-super-Mare, Mr. G. Stone of Burnham, Mr. W. Sellick and Mr. J. Brewer of Stolford. Much financial assistance has been received from the Colston Research Fund of the University of Bristol and, during the past year, from the Leverhulme Trust out of the grant made in support of the Biological Survey of the Bristol Channel which is being carried out from the Department of Zoology, University of Bristol.

FAUNA LIST*

Class PISCES

CHONDRICHTHYES

ORDER CYCLOSTOMI

Petromyzontidæ

PETROMYZON MARINUS L. Lamprey

The lamprey is recorded in the Severn by Smyth (1639). He remarks concerning it "a fish of note and eminency, entringe this River with the new yeare and then of five months abode; whose ancient and olde estimation conceive by theis Records in the Tower of London."

Day (1880), says "Henry I is said to have paid with his life from too great an indulgence in this article of diet. His successors, however, undeterred by his fate, continued this article of luxury constantly sending to Gloucester for a fresh supply and such was oftentimes employed as a ready road to court favour. King John fined the city of Gloucester fourty marks because 'they did not pay him sufficient respect in the matter of lampreys' while he issued a royal license that certain persons were permitted to purchase this article." He sent a palfrey to the Earl of Chester in return for a single lamprey.

Smyth again referring to the above Records in 2l. H. III, says that "the king then being at Canterbury by his writ commands the Sheriffe of this County to bake for him all the lampreyes hee can gett and to send them to him by his cooke. And when hee shall bee neerer Severne then to send them unbaked, as long as they may come sweet, for him and his Queene to eate."

And three years later, he "by his writ commands the Sheriffe not to suffer any man to buy any lampreyes but that hee buy and send

* The nomenclature throughout is that employed in the *Plymouth Marine Fauna* 1931, 2nd Edition.

them all to him whersoever hee bee, for all the Lent." Six years after he requires him "to send two parts of all the Lampreies hee can buy or get to him to Norwich and the other third part to his Queene to Windsore Castle."

"And in Berkeley Castle is an accompt of the keeper of the Wardrobe in 41.E.III which shewes that Maurice, Lord Berkeley in December sent the kinge six lampries which cost him £6 7s. 2d. and the carriage of those six to the kinge cost 6s. 8d. and in April followinge sent the Abbot of Glastonbury other six lampries which cost him 31s. 6d. But enough of this lamprey though of them the fishermen never thinke they have enough; such continueth their estimation to this day."

Again, Day states that "It should be mentioned that in the second year of this same reign Thomas, Lord Berkeley, had been sent by the king against the Scotch and 'took with him from Berkeley nine lamprey pies.' At this time they fetched 6d. to 8d. each, a price sufficiently high to restrict them to the upper classes."

"Henry IV granted protection to ships that brought over lampreys for the table of his royal consort while his successor issued a warrant to William of Nantes to supply him and his army with lampreys whenever they should happen to march. The custom of presenting these fish to the King was continued up to 1830, 'a lamprey pie embelished with gilded ornaments was sent annually, as a Christmas present, from the Corporation of Gloucester'."

Randall (1882) observes "Lampreys too which were formerly considered of more importance than salmon and were caught in the upper Severn, have altogether ceased to visit it since the erection of the first weir in 1843. An old man at Bridgnorth says the lampreys were called 'lamper eels' and the small lampreys 'lamperns,' and that the lamper eels were formerly speared on the fords, at the bottom of which they excavated a sort of trench, burying their heads and flapping their tails."

"Passing on to the present time (Day, 1887), a good lamprey costs from 1s. 6d. to 3s. 6d. The art of cleaning these fish is now being lost for certain persons used to devote their time to this occupation. The fish is put in 'lye' (charcoal) next it is cleaned while the vertebral column must be entirely removed."

Further, in 1890, Day states that "these fish were pretty abundant in the upper portion of the Severn up to within recent years, but decreased very perceptibly within twelve to fourteen years since."

They were captured by bargemen far above Shrewsbury; some fishermen took them by means of bush nets and one plan was to pass a hand into a stocking and then in a punt provided with a steady boatman to drop quietly down a shallow, when one or a pair of these fish would not uncommonly be seen. The boat was stopped and the fish if possible seized by the covered hand. They were supposed to be blind from not moving when anyone was in their close vicinity. Large numbers were likewise captured in the tidal portion of the river, but everywhere they have decreased in numbers and now appear to be unknown in the higher districts of the Severn."

The lamprey still ascends the Severn during the spring. They have been taken in small numbers then only in the Berkeley kypes.

LAMPETRA FLUVIATILIS Gray Lampern

The 'lamperne' is recorded by Smyth (1639) in the Severn. Baker and Day both record it in the Bristol Channel. Day (1890) remarks that "the lampern although much diminished of late years still affords much occupation to fishermen in the lower portion of this river and numbers are taken in cruives or wheels about and below Tewkesbury. In the autumn . . . large numbers are taken but the amount is uncertain; in a good night they may be counted by thousands. The season for their capture has varied from the beginning of October to the end of March. They are largely sold for bait to the cod fishermen."

"They were sold at a penny each at Worcester in 1882, and at Tewkesbury in 1884, at fifty shillings per thousand for bait or six shillings a hundred for potting. They are obtained during June, July, and most of August by shovelling out the mud in certain suitable spots when along with it fish are thrown on shore."

Numbers are taken in the kypes at Oldbury and Berkeley during each autumn, and there was a large run during November, 1939.

LAMPETRA PLANERI (Bloch) Small Lamprey

Day and Baker found it in Somerset. Two specimens in kypes, Berkeley, November, 1938.

ORDER ELASMOBRANCHII

Scyllidæ

SCYLLIUM CANICULA (L.) Lesser Spotted Dogfish

Probably the "hound fish als the dog fish" referred to by Smyth

(1639). Baker (1851) records it, and in Day's time it was common at Weston during the sprat season; a few specimens are taken there on long lines during the winter. During April, 1938 and 1939, a number of recently hatched fish were taken at Oldbury. Egg cases are taken in the shrimp nets in Bridgwater Bay during the spring; also found by R. Bassindale attached to *Tubularia* at Kilve and Blue Anchor.

SCYLLIUM CATULUS Cuvier Large Spotted Dogfish

Locally called "catfish." It is taken on long lines at Weston and was formerly thrown away but now finds a ready market.

Carchariidæ

GALEUS VULGARIS Fleming Tope

Recorded by Baker and Day in the Bristol Channel. Matthews (1933) records it as far up as Aust.

LAMNA CORNUBICA (Gmelin) Porbeagle

Day records a specimen washed ashore at Swansea in 1835 and another caught between Weston and Steep Holm in 1871.

Spinacidæ

ACANTHIAS VULGARIS Risso Piked Dogfish

Recorded by Baker and, according to Day, not uncommon during the sprat season at Weston. Specimens of all sizes occur on the longlines during the winter. One young fish in kypes at Oldbury, 12.4.38.

Rhinidæ

RHINA SQUATINA (L.) Angel Fish

Day records this species off Swansea and, from the description given, one specimen was found in the kypes at Oldbury, May, 1939.

Rajidæ

RAJA CLAVATA L. Thornback

Probably the "wray" found in the Severn in Smyth's time. Small specimens were taken by Day at Weston. Large sized fish are

common both here and at Stolford. At the latter fishery, during September, 1939, over one hundred fish were taken by a single fisherman. Small specimens about six inches long are occasionally found in the Severn during the autumn. Egg cases taken in the shrimp nets in Bridgwater Bay in the spring.

RAJA MACULATA Montague Spotted Ray

Occasionally taken at Stolford.

RAJA NÆVUS Müller & Henle Sandy Ray

Essentially a northern species according to Day. Very common in swing nets at Weston, December, 1939 and 1940.

RAJA MACRORYHNCHUS Raf. Flapper Skate

Taken by Baker in Somerset, 1851.

RAJA BATIS L. Skate

Small fish were present at Weston in 1879. According to Matthews it is fished commercially but is not so abundant as the Thornback. At the present time examples are rare in the Bristol Channel.

OSTEICHTHYES

ORDER GANOIDEI

ACIPENSER STURIO L. Sturgeon

Smyth (1639) records this fish in the Severn. "If a Sturgeon bee taken, in whose severall fishings or putts soever, it is the Lord Berkeleis and by the taker to bee brought to his Castle of Berkeley; howbeit the Lord of Custome gives the taker upon delivery of the Sturgeon halfe a mark in money and a longe bowe and two arrowes or half a noble in leiu thereof;" £1 was paid, in 1885, for every Sturgeon brought to the Castle, according to Mr. Cooke the then Steward of the Berkeley Estate.

Two or three fish are usually taken during the summer in the upper reaches. Smyth remarks that "experience assures us that the Lesser the Sturgeon is the more wholesome and tender and the belly to bee preferred before the back."

A 6 ft. specimen weighing over one hundred pounds was caught on a sprat-baited long line at Weston on January 10, 1941.

ORDER TELEOSTEI

Clupeidæ**CLUPEA HARENGUS L. Herring**

Seebohm (1915), states that "about the date of the Norman Conquest, the manor of Tidenham¹ was let on lease by the Bishop of Bath to Stigand, Archbishop of Canterbury and as a portion of the rent reserved was six porpoises (merswin) and thirty thousand herrings."

This species was present in the Severn in the 13th Century, as sundry Rolls in the Tower of London "shewe that noe yeare passed but that the kinge had Lampreys and heryngs from Seaverne." According to the General Committee Book of Bristol Council, 1801, "these fish have not been known to frequent the Bristol Channel in any quantities during either the last or present season."

Knight (1902), records that great quantities of herrings were sometimes caught off Steep Holm. Adults are rarely taken but occasional stragglers appear at all stations. Large numbers of small fish appeared in the sprat shoals during December, 1940, at Weston.

CLUPEA PILCHARDUS Walbaum Pilchard

There was no commercial fishing for this fish in the Bristol Channel in 1801. Recorded by Day and Matthews. Three specimens in nets at Stolford, May, 1940.

CLUPEA SPRATTUS L. Sprat

Smyth (1639) records it as present in the Hundred of Berkeley. From time immemorial the winter migration of sprats into the Bristol Channel has provided an important commercial fishery.

Baker (1928) says "In olden days many religious houses had the right of a Several Fishery and also many a Lord of a Manor had, and still has, a Several Fishery from having immemorially enjoyed it so as to exclude the public right. The Several Fishery of the Lord of the Manor of Weston-super-Mare is an exceedingly ancient one. Quite lately we have been fortunate to come across the De Banco Plea Roll of 7.H.VII in the Record Office which carried us back to 1442. This Roll sets out the proceedings in an action brought by one John Payne who asserted a title to the fishery against John Arthur, the then Lord of the Manor of Weston for forcibly fishing in his Several Fishery at Weston and carrying away Fish to the value of £20 and

¹ The manor of Tidenham is situated at the junction of the Wye and Severn.

as he the plaintiff quaintly stated, committing other enormities on him to the grave damage of him, the said John Payne.

It was the custom during the 17th Century and probably before, for the Lord of the Manor of Weston to grant leases of his tenements for the lives of two, three or four people and to give as appurtenant to the holding the right to occupy and fish two or three fishing stalls in his private fishery on the fore shore of Weston Bay chiefly at or near Birnbeck. This privilege was much prized, providing as it did food during the winter months.

John Payne by John Colyn his Attorney complained that John Arthur with ten of his servants by force and arms on 30th of November, 1491, fished in his Several Fishery and took one hundred horse loads of fish called "Barons,"² four hundred young cod or Tubbelyns as they are still called, three hundred Haddockes and two hundred whitynges. John Arthur and his servants deny coming by force and put themselves upon the County (that is demanded trial by jury) and said further that John Payne ought not to bring his action for trespass as the place where the trespass was supposed to have been committed was ten acres of land called Anchor's Head which were daily covered with salt water and were parcel of the Manor of Weston of which John Arthur was absolute owner. John Payne replied that he and his ancestors had a Several Fishery from time immemorial in seven stalls fixed in half an acre of land, part of the ten acres with nets fixed to the posts of the stalls and he demanded judgement in his favour. The result of the case is unfortunately unknown."

The following extract is taken from the Minutes of the General Committee Book of Bristol Council, 1801: "from the investigation they have made into the State of the Fisheries in the Bristol Channel as to the success of . . . the future operation of the Bounties if continued by Parliament, viz., Spratts. Your Committee observe that a great part of the supply of this Fish is derived from Basket and Stake Netts on the shores of the Severn from whence Spratts are daily brought by the fishermen to Market in quantities of from twenty to fifty pounds. It is only the second year that any attempt has been made in this Channel for them in deep Netts but this attempt seems likely to succeed if further encouraged." This is probably a reference to the use of apron nets which has now ceased.

Rutter (1829) says "during the sprat and herring season . . . the

² The "baron" is the "sprat Barne" mentioned in Carew's *Survey of Cornwall*, 1602.

fishermen in Weston who rent the stands go on donkeys and ponies after every tide to collect the produce of their nets. Numerous jobbers are in anxious attendance to purchase the marine harvest and the children of the village with happy faces, flock to Birnbeck with their baskets, to glean the fish which have fallen from the nets; and which from time immemorial has been considered their perquisite."

Baker (1851) adds that "by the middle of the 19th Century the sprat had become the most valuable fishery on the Somerset coast. They are caught by stake nets and brought to the markets every day and sometimes after every tide. As much as a ton of sprats was known to have been retailed in Taunton market in one day and from information collected with great care, I learn that the sprat fishery from the west end of the Gore Sand in Bridgwater Bay to Weston-super-Mare will produce in a good season more than £10,000 at the retail prices. Sprats strung and suspended in lines from the kitchen ceilings are to be seen in the cottages for months after the season is over. The sprat and herring fishery of Weston supported great numbers of the poor in the time of its greatest activity."

Further, Baker (1928) remarks "Two gull yellers were kept on Birnbeck island, for a month or two continuously, living in a little hut and feeding mainly on sprats. One man attended to the eastward stalls and the other to the westward fishery; they were paid £1 a week each, each fisherman contributing an even proportion towards their wages according to the number of stalls rented. One, Bill Hurle, could be heard as far as Congresbury Bridge."

Small sprats are present at all times throughout the Estuary, but the adults rarely appear in numbers as far up as Oldbury. Fished commercially during the winter by means of swing and stow nets at Weston and by baskets throughout the Estuary of the Severn. A greater quantity of sprats was taken at Weston during the winter of 1940-41 than for twenty years previously.

CLUPEA ALOSA L. Allis Shad

Recorded by Smyth in the Severn. Randall (1882) says that "shad were formerly taken in considerable numbers by men who stood at the fords, watching for them as they ascended the river at night. Their approach was marked by a phosphorescent light or 'loom' in the water. They were difficult to catch in the day time as they could go over or under the net. When in proper condition they were a well favoured fish and attained 2-3 lbs. in weight."

Day (1890) observes that "it is asserted that in the tidal portion of the river, the value of the shad and twaite, in times gone by, equalled if it did not surpass, that of the salmon. It is observed entering the Severn about the middle of April, but the time depends to a considerable extent on the condition of the water, as it does not appear to like to face Severn floods, waiting until such have subsided. When migrating into the river, small males arrive first, but subsequently larger ones. The shad is sometimes taken as far up as Worcester but has diminished in recent year most likely consequent upon the navigation weirs; in fact, in the year 1869, it was noticed . . . that the run of shad and twaite up the river was very large during the spring, much better than it had been known for years. While in 1872 the taking of two shad near Shrewsbury was worth recording."

There is still a small run of these fish every year.

CLUPEA FINTA Cuvier Twait Shad

Recorded by Smyth (1639). Day (1890), referring to his above remarks on the Allis Shad, says "if this has been the effect on the larger form it has been equally or more disastrous to the smaller twaite which arrived two to three weeks later. It is likewise a fish that will at no distant date be almost or quite extinct in the river for it is unable to attain access to its spawning beds. The young which used to descend in shoals 'like autumn leaves on the river,' are now seen in a few dozens at a time or more likely two or three together. One old fisherman states that 'about forty years since fishing during one night we took one hundred and sixty-four dozens at Bollow Pool'."

These fish swim very rapidly and are often taken impaled on stakes or wedged between the baskets in the Severn. They are locally called 'May fish.'

ENGRAULIS ENCRASICHOLUS (L.) Anchovy

Jones (1865) says "sometimes caught to the number of twelve in a tide in salmon puts at Sharpness." Matthews recorded it as far up as Oldbury; occasional visitor in the Severn during the summer. Baker (1851) states that large numbers are taken at Stolford in May and June. Three specimens at Stolford in nets; 9.6.39.

Salmonidæ

SALMO SALAR L. Salmon

The origin of the use of "fixed engines" for capturing salmon in

the Severn is lost in antiquity. Seebohm (1915) considers that the "cytweras and hoecweras mentioned in the Manor of Tidenham in the Domesday Survey seem to point to wattled basket and hedge weirs rather than to the solid structures now called weirs." Day (1890) states that "Especial attention was drawn in Magna Charta to the injurious practice of the Crown evading the laws formulated for the benefit of the fisheries and allowing certain individuals to set up cruives and weirs and it was enacted that 'all weirs from henceforth shall be utterly put down . . . through all England except the sea coast'."

According to evidence given by the ferryman at the Old Passage, near Chepstow, before the Select Committee on the Salmon Fisheries (1825), putchers were made in January and were fixed in the river as soon as completed. They remained the whole year round as long as they lasted, and took fish in and out of season equally. About nine thousand baskets were present in about five miles of the river's length on the Gloucester side. At the same time the harmful effect of fixed and moveable small mesh nets, fixed machinery in weirs and putts or wheals, which take millions of young fry in a night, was described. These fish were given to the pigs. Large numbers of spawning salmon were speared in both the Severn and Wye and "kippered."

In consequence of the complaints of salmon destruction, an association was formed at Gloucester in 1801 with the object of enforcing the law. In an Act of 1861, fixed engines were declared public nuisances and abolished unless an ancient right prior to Magna Carta could be shown.

Later, before another committee in 1870, the suggestion was advanced that the basket should be fixed with an engine to prevent the salmon entering during the close season, and this is now legally necessary. About seven thousand putchers were certified at this time. They then possessed a weekly close time and were not usually put in until the beginning of April, owing to possible damage by flood waters and the poor run of fish. Lave, beating, draft, haaf, and stock nets were in use at this time in the Severn and Wye.

The stop net fishery at the mouth of the Wye, formerly owned by the Duke of Beaufort, is over four hundred years old, and in 1870 was worth five hundred pounds a year. Concerning this type of fishing, Day (1890) remarked that "it was the most killing plan of

taking salmon" he had ever seen, a line of boats, using stop nets, being moored across the tide-way of the Wye.

The same author says that "In 1740, the salmon nets were required to have $2\frac{1}{2}$ ins. mesh and to be of fixed lengths in various parts of the river; nor more than one of these nets to be fished at once." In 1861 the mesh was altered to 6 ins., but in 1870, although legally 8 ins., many fish were taken by $5\frac{1}{2}$ ins. mesh nets used for twaite.

The importance of preserving the race, by fixing a close season, was early realised and "in 1424 a poacher who exercised his vocation during this time had to lose his life" (Day, 1890). The Severn regulations in 1740 included a close time between September 8 and November 11; no young fish were to be captured between mid-April and June 24. In 1861 it was altered to extend from September 1 to February 6 inclusive, and the "Saturday Slap," as it was known, from 6 a.m. Saturday to Monday. Later, in 1890, the closing date was altered to February 2; at the present time it extends from mid-August to mid-April.

Smyth (1639) says "The salmon growes by theis degrees and ages, 1. a pinke 2. a botcher 3. a salmon trout 4. a gillinge 5. a salmon. Soe in perfect and full age at five yeares as an ox or bucke. And (generally) in this part of the River the prime season for the goodnes of the salmon goes out when the Bucke comes in and comes in when the Bucke goes out. The belly of the salmon is tenderest, sweetest and pleasantest and his eies wholesomer then of any other fish."

Day (1879) says "In Edward III's time a salmon was worth 1s. 4d. to 1s. 8d. and the best 2s. 0d." In 1890, he continues "The Notes and Queries for May 1857 quoting Coursell's History of Gloucester which says 'It was a standing condition of apprenticeship that the apprentice should not be obliged to eat salmon more than thrice a week, the object being to render him less liable to the leprosy, which after the Crusades in the Middle Ages was a formidable disease that was supposed to be brought on or aggravated by the eating of fish.' In a History of Worcester the existence of this proviso is asserted as a well-known fact. The Cromwellian trooper, Captain Franks, remarks 'the burgomasters are compelled to reinforce the ancient statute' cited above. A century later salmon were worth a penny a pound, while in 1775 they varied in price from 1s. 0d. to 1s. 6d. a pound at the commencement of the season falling to as low as 8d. a stone in July (Pennant)."

Salmon were so common at times that it is reputed that the fields were dressed with salmon manure and that a piece of salmon was always given to the thirsty travellers at local inns. These fish were taken in the fish weirs along the coast.

The run of salmon in the Severn is extremely variable. There have been relatively few fish during recent seasons, but in 1940 a large number of fish were taken. Eighteen salmon were caught in one rank of putchers at Cowhill, on one tide, a number never exceeded within living memory. The fish were chased into the baskets by porpoises which were present in the Estuary for some weeks during the summer.

The salmon pinks run down the river during May, and at this time all kypes must be left open. Two of these fish were taken in the swing nets at Weston during December, 1939.

SALMO TRUTTA Salmon Trout

Probably the "wheat trout or suen" recorded by Smyth. In 1890 Day states that "Salmon trout are not so numerous in the Severn as in some other rivers, it was asserted in 1860 that they were so uncommon that they were given to the fishermen as their perquisites." It is now so rare in the Severn that the fisherman who caught a single specimen in 1938 regarded it as a new species.

Anguillidæ

ANGUILLA VULGARIS Turton. Common Green Eel

Smyth records "the eele or fauzon, or great fat eele, elvers by some supported to bee the younge eele." Day (1890) says "The minute eels which ascend from the sea or estuary are termed elvers and are gathered in vast quantities for making cakes. Three tons weight were despatched from Gloucester on one day in May, 1886. These elvers had been protected by legislation from the time of Charles II, but in the reign of George III so much of the former Act was repealed as related to a penalty on persons taking elvers for their own use and not for sale. But the Salmon Act of 1861 repealed the previous legislation and the destruction became so excessive that an official enquiry was made at Gloucester which resulted in the present law which authorises their being taken between March 1st and April 25th only. By some error this was not made to have effect in the Hundred of Gloucester where the destruction of these young eels goes merrily

forward. Eels are essentially the poor man's food and in an official report it was held that 'the unrestricted destruction of elvers was not shown to have any appreciable effect upon the supply of eels'."

The elvers appear in very large numbers on the highest tides of the spring equinox so that the water appears full. The inhabitants above Sharpness collect them in large quantities, attracting them at night with a light. At this time the river bank appears as well lit as a main street.

The net consists of a U-shaped piece of board about $2\frac{1}{2}$ ft. in diameter with a stout handle about 7 ft. long passing through a hole about 3 ins. below the straight edge. Two withy rods are fixed to the upper sides of the U and extend forwards about 5 ft. to the front of the net. Here they are joined by the leading string which is about 3 ft. long. Two cross withies extend from the same points, crossing in the centre and fixed to the back board. The handle is firmly fixed to the point of intersection. This frame-work is covered with muslin. In practice, the wire covers used for protecting meat are often fixed on to handles and used as nets.

The fish are freed from the slime adhering to them by placing them in a cheese-cloth bag and compressing it. They must be cooked within a short time, otherwise they tend to become tough. The first run elvers average nine hundred and fifty to the pound but towards the end of the season number about one thousand two hundred. A packing station has been maintained at Epney for a long time by the German Government for the purpose of exporting live elvers to the Continent for restocking their rivers. A few are also sent to Ireland for private lakes, etc.

Day further states that "In June, silver eels descend towards the mouth of the river with the first freshes, amongst which the largest breeding ones pass downwards from the end of September to about Christmas. These are the best for eating and are occasionally captured up to six pounds in weight. The glut-eels are a large-headed coarse form, probably sterile females which travel about and attain to six pounds in weight but are not observed migrating seawards. During March and April, they are in holes and are groped for by fishermen in the river banks. Green eels are small ones, eight to ten to the pound. We have stick eels which are small forms descending with the first freshes in August and averaging about four to the pound. When the elvers have attained six inches in length they are called eel bouts."

"Breeding eels are not constantly descending, for the eel traps are set to capture both ways, on the ebb and flow, as they are found to descend with the fresh water but as soon as they reach the flood, to turn back and reascend. This plan of capturing is why the eel traps below Gloucester take so many more than higher up the Severn for in the non-tidal portions the traps are said never to be faced down stream."

"Eels are likewise taken in the autumn months between Stourport and Gloucester in large fixed nets that are used when the water is discoloured by rain. There are about twenty of these nets and each net is probably employed on about ten nights yearly with an average catch of one hundredweight a night."

Eel traps are constructed of withy and possess two non-return valves inside; they are closed at the open end with a wooden bung. The basket must be made of old withy or else kept submerged for some weeks before eels will enter them. The eel trap must be set facing up river to ensure a good catch; the bait used is live shrimps.

Adult eels are caught at all times of the year, but in larger numbers during the spring and autumn. A favourite method of angling is by means of earth worms threaded on cobblers' twine. The teeth of the eels become entangled in the twine and they are rapidly hauled in.

CONGER VULGARIS Cuvier Conger Eel

Smyth includes in his list "the conger als the conger eele being the hee fish and the Shee fish is called a quaver."

Jones (1865) says "Congers of considerable size prowl over the sands at Sharpness and are sometimes left stranded upon them." Day found small specimens common under stones at Weston in 1879. Matthews remarks that they are said to be less abundant there than formerly. Small specimens up to two pounds in weight are taken at the Severn stations, but large fish only in the Bristol Channel.

LEPTOCEPHALUS CONGRI VULGARIS

"This curious and rare little fish has often been brought to me from Stolford, in the summer," remarks Baker who called it the 'Anglesey Morris.' One was taken at Framilode in May 1845, according to Jones (1865). Two specimens in shrimp nets at Stolford 20.5.39. The fishermen say that they are taken occasionally in the spring, but none were taken in 1940.

Belonidæ

BELONE ACUS Risso. Garfish

Possibly the "horncake" mentioned by Smyth (1639) as occurring in the Severn. Day (1879) took them occasionally at Weston, and Matthews records them in the Severn. According to the fishermen, they are present at Stolford occasionally but no specimen taken in 1939 or 1940.

Exocoetidæ

EXOCEOTUS VOLITANS L. Flying Fish

Baker (1851) mentions that two or three were blown ashore at Burnham and another in 1832 ten miles from Bridgwater, a notice of which was communicated to the Linnean Society. Day also records it in Somerset.

Gasterosteidæ

SPINACHIA VULGARIS Flem. Fifteen Spined Stickleback

Day records a museum specimen at Weston, and it was frequently taken at Stolford by Baker. Matthews states that it is uncommon above Bridgwater Bay. One specimen in kype at Severn Beach 10.1.38; one specimen in shrimp nets at Burnham 6.1.40.

GASTEROSTEUS ACULEATUS Will. Three Spined Stickleback

Jones (1865) found specimens in a pool at high water mark at Sharpness. It was common at Weston in Day's time. It is fairly common at all stations in the Estuary and, according to various authorities, appears to live and breed equally well in salt and fresh water.

GASTEROSTEUS PUNGITIUS L. Ten Spined Stickleback

Baker records it in Somerset. Day includes it in his list of fresh water fishes found in the Severn. One specimen in hand net at Epney 8.3.40.

Syngnathidæ

ENTELURUS AEQUOREUS (L.) Ocean Pipe Fish

Day records it in 1890 from near Bridgwater. Occasional specimens are taken as far up as Severn Beach.

NEROPHIS OPHIDION (L) Straight-nosed Pipe Fish

Day (1890) near Bridgwater. Occasionally captured in the nets at Bridgwater Bay.

SYNGNATHUS ACUS L. Greater Pipe Fish

Day also records this species near Bridgwater. Occasionally taken as far up as Severn Beach.

SYNGNATHUS TYPHLE L. Broad-nosed Pipe Fish

Day (1879) records it; two specimens at Stolford 3.5.39 and 6.8.40.

HIPPOCAMPUS GUTTULATUS Cuvier Sea Horse

Dillwyn (1848) recorded it in Swansea Bay. One in shrimp nets at Stolford about 1933.

Balistidæ**BALISTES CAPRISCUS Gmelin** Trigger Fish

Specimen in Weston Museum recorded by Day.

Orthogoriscidæ**ORTHAGORISCUS MOLA (L.)** Sun Fish

Smyth (1639) records it in the Severn. Day (1879) mentions that it is said to have been seen off Somerset and, in 1890, records it from near Bridgwater. A specimen taken in Cumberland Basin in 1900 is in the Bristol Museum. One or two specimens are taken every summer at Ilfracombe and exhibited to the public on payment of one penny.

RANZANIA TRUNCATA (Retzius) Oblong Sun Fish

Recorded by Day near Bridgwater in 1890.

Ammodytidæ**AMMODYTES LANCEOLATUS Lesauvage** Greater Sand Eel

Day quotes Baker (1851) as authority for its presence in Somerset. Rare; one in kype at Oldbury 20.3.38; three in nets at Stolford 9.6.39, 11.10.39 and 17.10.40; two in nets at Weston, December, 1 39. Fairly frequent in swing nets at Weston in January, 1941.

AMMODYTES TOBIANUS L. Lesser Sand Eel

Day (1879) records its presence at Weston, and Matthews (1933) observes that it is found as high up as Portishead. One in kype at Oldbury 28.1.38.

Atherinidæ**ATHERINA PRESBYTER Jenyns Sand Smelt**

Recorded without comment by Day (1879) at Weston. Occasionally taken in kypes at Oldbury 1938, but absent during 1939 and 1940; a few stragglers caught infrequently at Stolford.

Mugilidæ**MUGIL CHELO Cuvier Thick-lipped Grey Mullet**

Smyth (1639) records "the millet als mullet" at Berkeley. At the present time this species is more common than the thin-lipped mullet. They are reputed to breed near Highbridge in the R. Parret, and large numbers of small specimens, about three inches long, are taken during the summer and autumn in the shrimp nets in Bridgwater Bay. It is occasionally taken as far up the Severn as Oldbury. Specimens were taken by R. Bassindale from a fresh water stream drainage pool near H.W.M. at Kilve (18.8.39) and at Ashleworth Ferry (22.8.39).

MUGIL CAPITO Cuvier Thin-lipped Grey Mullet

An occasional visitor according to Day.

Gadidæ**GADUS ÆGLEFINUS L. Haddock**

Smyth records it at Berkeley and it was taken on lines at Weston in Day's time. Matthews states that it is occasionally caught in the Bristol district. Rare visitor.

GADUS MORRHUA L. Cod

In the Severn district called "Tubbelin whiting." This species is mentioned by Smyth (1639) at Berkeley and by Day (1879) at Weston. Day (1890) states that the lamperns taken in large numbers around Tewkesbury are sold to the cod fishermen for bait. A spiller fishery existed at Hallen until a few years ago. There is no commercial cod fishing above Weston at the present time. Matthews (1933)

records large fish as being abundant in winter as far up the river as Sheperdine. Few large cod have been caught here in recent years. At Weston, however, the winter long-lining provides some sizeable examples.

During the summer of 1939 more small cod were present at Stolford than had been seen by the fishermen for twenty years. At the peak of the run in July, hundredweights of fish about four inches in length were caught. They migrated up the Severn as far as Oldbury during the autumn, but as they increased in length, became less numerous. Finally, they were absent from all stations in January, 1940, when there were exceptionally severe frosts. There has been no similar migration of young fish into the Channel during the summer of 1940.

GADUS LUSCUS L. Whiting Pout

Day found this species at Weston, and Matthews records it as very numerous. Specimens were taken as far up as Oldbury in 1938 and are fairly numerous at the lower stations during the summer.

GADUS MINUTUS L. Poor Cod

Occasionally caught at Oldbury in the kypes. Matthews (1933) records it as very numerous but it is not so common now.

GADUS MERLANGUS L. Whiting

Mentioned by Smyth in the Hundred of Berkeley and by Day (1879) on long lines and in shrimp nets at Weston. Later, in 1890, he writes "thus at Lydney, last August, the shrimpers in the Severn were taking large quantities of the young of the whiting, but of too small a size to be useful for food." Small specimens are common at all stations throughout the year and increase greatly in numbers during the summer. During the autumn of 1939 the appearance of young whiting about six inches long coincided with the gradual disappearance of the young cod at Stolford. This migration reached Oldbury in December and January. During the spring (1940), hundredweights of small whiting were taken during May at Stolford, and as they increased in size to six to seven inches in June, became fewer. There were only occasional stragglers left in September. There is an autumn migration of large specimens which are taken as far up as Oldbury.

GADUS POLLACHIUS L. Pollack

Day found this species in the trammel nets at Weston. Matthews

states that small examples under a foot in length are common in the Bristol district. Comparatively rare now.

GADUS VIRENS L. Coal Fish

Knight (1902) records this species at Weston.

MERLUCCIUS MERLUCCIUS (L.) Hake

Mentioned by Smyth (1639) at Berkeley and recorded from Weston by Day (1879) and Knight (1902). Four small specimens, about half a pound, were taken on one tide at Stolford in July, 1939, and occasional fish were still present in August. A few were taken in October, 1939, at Oldbury, but they are rare visitors to the Severn. One specimen at Stolford in May, 1940.

PHYCIS BLENNOIDES (Brünn) Greater Forkbeard

Baker (1851) records it as rare in Somerset. Day (1879) found it at Weston, but there are few specimens taken there now. One at Oldbury in kypes, 28.3.38.

MOLVA VULGARIS Fleming Ling

Recorded in the Severn by Smyth (1639) and from Weston by Day and Knight. An eighty pound fish, caught by Mr. Pullen at Severn Beach some years since, was probably a ling.

ONOS MUSTELA (L.) Five Bearded Rockling

Is locally called the "slippery cod" and is eaten by the fishermen, when fish are scarce, at Stolford. Day found this species in Somerset and it is very common according to Matthews. These fish were very numerous at Stolford during the autumn of 1940; also recorded by R. Bassindale from Weston, 17.8.39.

ONOS TRICIRRATUS (Bloch) Three Bearded Rockling

Recorded by both Day and Matthews. It is not as common as the preceding species. Taken during the winter of 1941 in the swing nets at Weston.

LOTA VULGARIS Cuvier Burbot

Smyth (1639) records this species as the "eele pout" under his list of fish in the Hundred of Berkeley. Three specimens were obtained

during the spring of 1938. Two, measuring 9 cm. and 10.5 cm. long respectively, were caught during February at Oldbury, and the third, 11.5 cm., during March at Severn Beach. These appear to be the first modern records of this fish in the West of England, although it is not uncommon in the rivers which flow into the North Sea between Durham and East Anglia and is of general distribution in northern and eastern Europe (Lloyd, 1938).

RANICEPS RANINUS (L.) Lesser Forkbeard

Baker (1851) records it as rare in Somerset. Specimens were taken occasionally during 1938 in the kypes at Oldbury, but none have been seen since at any station.

Blenniidae

BLENNIUS GATTORUGINE Bloch Gattorugine

Local example in Weston Museum recorded by Day. One specimen in kype at Oldbury, 4.4.38.

CENTRONOTUS GUNNELLUS (L.) Butterfish

Day (1890) considers that it was a specimen of this species which Baker took at Stolford in September, 1838, and sent to Yarrell who had never previously seen a 'Beardless Ophidium' as he named it.

Trachinidae

TRACHINUS DRACO L. Greater Weever

Baker says that both species of weever were present in Somerset, but were not abundant. A single example is in Weston Museum, but no specimens have been taken during this survey.

TRACHINUS VIPERA Cuvier & Valenciennes Lesser Weever

The rarer species in Baker's time; Day mentions that the fishermen rarely catch it. It is only occasionally taken in Bridgwater Bay.

Callionymidae

CALLIONYMUS LYRA L. Skulpin

Baker (1851) states that it is not uncommon in Bridgwater Bay and Day records the species from Weston. Occasional specimens in swing nets, Weston, December, 1939 and 1940.

Cepolidæ**CEPOLA RUBESCENS L. Red Band-fish**

Baker (1851) records it as rare, but a few were taken in the estuary of the R. Parret about this time; no specimens taken in recent times.

Lophiidæ**LOPHIUS PISCATORIUS L. Angler Fish**

In the Minutes of the General Committee Book, Bristol Council, we read "Also this year on the tenth of April, 1607, there was a strange Fish caught in King Road and brought to the Back in a boat of Cardiff, the fish was called a Fryar being five foot in length and three foot in breadth having two Hands and two Feet and very Grisley and Wide Mouthed, he was Hall'd on a Hallier's Dray to Mr. Mayor's House."

Couch (1864) says that a specimen of a supposed separate species *L. europæus* caught in Bristol Roads in 1763 was probably a variety of the common species.

Baker (1851) records an eighty pound fish taken in the R. Parret. Jones (1865) mentions one caught at Newnham a few years since. Large specimens were occasionally captured at Weston in Day's time. During the summer, occasional fish of all sizes appear in the Severn, one six feet long being washed into the kypes at Berkeley in 1939.

Gobiidæ**GوبيUS (GوبيUS) PAGANELLUS L. Rock Goby**

One specimen in shrimp net at Stolford, January, 1939.

GوبيUS NIGER L. Miller's Thumb

One specimen taken by R. Bassindale near L.W.M. at Weston, 17.8.39.

GوبيUS (GوبيUSCULUS) FLAVESCENS Fabricius Two spotted Goby

Day and Matthews state that it was not uncommon in their times in the Weston district.

GوبيUS RHODOPTERUS Günther

According to Day it was not rare at Weston in 1879.

GوبيUS (POMATOSCHISTUS) MINUTUS Pallas Common Goby

Jones (1865) took one in a high water pool at Sharpness. Both Day and Matthews found it very common throughout the Estuary.

It is usually abundant, but the adults disappeared during the summer, 1939, and small young specimens appeared in stramin samples taken at Stolford during July. Gobies of all sizes reappeared at all stations during October, remained during the winter, but were absent again during the summer of 1940.

Probably other species of Gobiidæ were present at Weston in 1879 "whence the Yellow Goby, the One-spotted Goby, the Speckled Goby, the Transparent Goby and the Slender Goby had been obtained," according to Day.

APHYA PELLUCIDA (Nardo) Transparent Goby

One specimen in Stolford nets, May, 1939; relatively numerous in July and August, 1939; absent in 1940. It is not caught at any of the higher stations in the Severn.

Pleuronectidæ

PLEURONECTES FLESUS L. Flounder

Smyth (1639) says "the flooke als the flounder" inhabits the Hundred of Berkeley; it is still called locally by the former name. Day (1890) states that "the flounder has been destroyed from the upper water of the Severn since the erection of navigation weirs in 1842. Prior to this they were taken with a worm at Shrewsbury, and so common were they in the spring that certain fishermen earned a livelihood by their capture." There were no flounders in the Severn during the summer and autumn, 1939. Large numbers were caught at Stolford during May and June, 1940, but decreased in numbers during the autumn. These fish appear to congregate in large numbers in certain areas only.

PLEURONECTES PLATESSA L. Plaice

Smyth says "Of the Plaice wee say quanto grandior eo melior." Merely recorded by Day (1879); occasionally taken throughout the Estuary.

PLEURONECTES MICROCEPHALUS Donovan Smear Dab

Baker records it as rare, and Matthews as an irregular visitor.

PLEURONECTES CYNOGLOSSUS L. Pale Fluke

Baker (1851) took two specimens at Stolford and sent them to Yarrell who considered that they represented a new species, *P. elongatus*.

Higgins (1861) subsequently took two specimens at Weston, and Day (1879) also records it there.

PLEURONECTES LIMANDA L. Dab

Day (1879) took it at Weston. It is extremely common and is fished commercially at all stations.

RHOMBUS MAXIMUS L. Turbot

Recorded by Smyth in the Severn and by Day and Matthews at Weston. Small specimens occasionally visit the Estuary.

RHOMBUS LÆVIS (Rondelet) Brill

Occasionally taken at Weston according to Day and Matthews. It was taken during the summer as far up the Severn as Oldbury in 1938; occasionally taken at the lower stations at all seasons.

LEPIDORHOMBUS WHIFF (Walbaum) Sail Fluke

Day and Matthews record it at Weston.

SCOPHTHALMUS NORVEGICUS (Günther) Muller's Topknot

Day (1890) records it in Somerset.

ZEUGOPTERUS PUNCTATUS (Bloch) Common Topknot

Rare; two specimens taken, one at Oldbury 2.2.38, and another at Severn Beach about the same time.

ARNOGLOSSUS LATERNA (Walbaum) Scald Fish

Recorded by Baker (1851) and Day (1879), but none since.

Soleidæ

SOLEA VULGARIS Quensel Common Sole

Smyth (1639) says "The Sole wee call our Seaverne Capon, A meate of prime note." Recorded by Baker and Day in the Bristol Channel. A few young specimens about four inches long are taken in the Severn during each summer. Large numbers, of a similar size, were taken at Stolford in September, 1939, and in the summer of 1940. Small specimens, up to one inch long, netted in water and on mud at Kilve by R. Bassindale, 21.5.39. Adults are only taken in small numbers in the Bristol Channel.

SOLEA VARIEGATA (Donovan) Variegated Sole

Baker and Day found it in Somerset. Occasional specimens at the lower stations.

SOLEA LUTEA (Risso) Little Sole

Baker and Day found it in Somerset. Occasional specimens at the lower stations.

SOLEA LASCARIS (Risso) Sand Sole

Recorded by Baker and Day in Somerset. Small specimens occasionally taken at Weston. Probably the "sand flooke, resembling the sole," recorded by Smyth.

Triglidae*TRIGLA GURNARDUS* L. Grey Gurnard

Smyth (1639) mentions "a gurnard, both red and grey." Day (1879) states that it is the commonest of the gurnards. This is still true; numbers of small specimens, two to five inches in length, were taken during September, 1940. During the greater part of the year it is much rarer. One adult in kypes at Oldbury, 30.4.38.

TRIGLA HIRUNDO Bloch Sapphire Gurnard

Day (1879) took it occasionally at Weston.

TRIGLA CUCULUS L. Red Gurnard

Smyth (1639) and Day (1879) found it occasionally at Weston. Rare. Few specimens in swing nets at Weston, December, 1940.

TRIGLA LYRA L. Piper

Baker (1851) records it near Bridgwater, and Day (1879) at Weston.

TRIGLA LINEATA L. Streaked Gurnard

Day and Baker record it in the Bristol Channel. One specimen Stolford, 26.5.39.

Cottidae*COTTUS SCORPIUS* L. Short Spined Sea Scorpion

Day (1879) and Matthews (1933) record it at Weston as an occasional visitor. It is rare in the Severn (one specimen, 6.11.37), but young

specimens were taken in October, 1939, at Stolford, and in December, 1939, at Weston.

COTTUS BUBALIS Euphrasén Fatherlasher

Day (1879). Matthews records it occasionally at Weston in the winter.

Agonidæ

AGONUS CATAPHRACTUS (L.) Armed Bullhead or Pogge

Day (1879) mentions a specimen in the Weston Museum. It is fairly common throughout the lower parts of the Estuary.

Cyclopteridæ

CYCLOPTERUS LUMPUS L. Lump sucker

Recorded in the Severn by Smyth (1639) as the "lump fish." Day (1879) records its arrival in the winter, at Weston, causing havoc among the sprats. It was very common in the winter of 1933 (Matthews). Occasional examples were taken in the kypes at Oldbury in 1938, but none during 1939. Present at Weston in the swing nets in December, 1939. Locally called the "sprat pilot."

Liparididæ

LIPARIS VULGARIS Fleming Common Sea Snail

Both Day and Matthews record small specimens as being exceedingly numerous along the coast. Large specimens were common in 1937 at Oldbury and a few were present in January, 1940. Occasional specimens at the lower stations at most times.

LIPARIS MONTAGUI (Donovan) Montagu's Sea Snail

Both Baker and Day record this species in Somerset. Occasional specimens taken throughout the Bristol Channel.

Labridæ

LABRUS BERGGYLTA Ascanius Ballan Wrasse

Baker and Day record it in the Bristol Channel.

LABRUS MIXTUS Kröyer Cuckoo Wrasse

Baker and Day record this species in Somerset. One specimen in kype at Oldbury, 6.4.38; one in nets at Stolford, 8.8.40.

CRENILABRUS MELOPS (L.) Corkwing

Day records it in Somerset. One specimen taken in April, 1938, at Oldbury.

CTENOLABRUS RUPESTRIS (L.) Goldsinny

Recorded by Baker (1851) in Somerset.

CENTROLABRUS EXOLETUS (L.) Rock Cook

Rare; one specimen kype Oldbury, 1.4.38.

Carangidæ**CARANX TRACHURUS (L.)** Horse Mackerel

Two recorded at Oldbury, 25.10.37 and 11.10.40. According to the fishermen also taken at Stolford, but no specimens caught in 1939 or 1940.

Zeidæ**ZEUS FABER (L.)** John Dory

Smyth (1639) includes the "Dorry." Day (1879) records two specimens from Weston. Small specimens were common enough in the Severn in the summer of 1938, but none have been taken since at any station.

Caproidæ**CAPROS APER (L.)** Boarfish

Baker (1851) found specimens, from Stolford, in Bridgwater market and it appears that this was the second record of this species. A specimen was present in the Weston Museum in Day's time, but is missing now. One specimen taken in swing nets at Weston, December, 1940. This species had not been previously seen by the fishermen.

Serranidæ**POLYPRION CERMIUM Valenciennes** Stone Bass

Recorded by Baker and Day in Somerset.

MORONE LABRAX (L.) Bass

The "bese" is recorded by Smyth in the Severn. Baker (1851) records one, twelve pounds in weight, from the R. Parret. It was common in 1879 at Weston according to Day. Matthews (1933) mentions that small specimens are common round stream mouths.

Small fish are rare in the Severn at Oldbury, but examples of all sizes are occasionally taken in Bridgwater Bay. The adults come inshore in numbers when there is a stiff breeze; hence called locally "wind puffers."

Sparidæ

CANTHARUS LINEATUS (Montagu) Black Sea Bream or Old Wife

Possible the "huzwife" mentioned by Smyth (1639). One specimen kype Oldbury, June, 1938.

PAGELLUS CENTRODONTUS de la Roche Sea Bream

The "sea breame" is mentioned by Smyth (1639) and recorded by Baker (1851) and Day (1879).

Mullidæ

MULLUS SURMULETUS L. Red Mullet

Day and Baker record this in Somerset. Two specimens in kypes at Oldbury, 10.9.37.

Xiphiidæ

XIPHIAS GLADIUS L. Swordfish

Smyth recorded it in 1639. Baker saw one rotting on the sands at Burnham in 1850, about eight feet in length. In 1830 one was captured at Worcester after killing a man who was bathing in the river. The cast of a nine foot specimen, which was washed up on Burnham sands in 1873, is in the Weston Museum. Day (1890) states that it is occasionally taken in fresh water, especially in the Severn.

Scombridæ

SCOMBER SCOMBRUS L. Mackerel

This species was present in 1639 according to Smyth. Day and Matthews record it as a rare straggler at Weston. It is rarely taken at Stolford now. One specimen in swing nets at Weston, 28.12.40.

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Studies on the Biology of the Bristol Channel

VI

THE MARINE MAMMALS OF THE BRISTOL CHANNEL

By L. HARRISON MATTHEWS, M.A., Sc.D.

(*Read in title, March 1, 1941*)

‘**I**N a county having such an extensive seaboard as Somerset has on the north, it might be expected that seals and cetaceans would have occurred more frequently, but besides being out of their usual track the waters of the Channel are so discoloured by Severn mud, and also by the mud brought down by the Parret into Bridgwater Bay, that the coast is exceedingly poor in marine life and offers but little attraction to these animals.” Thus wrote Charbonnier (1906) in the *Victoria History of the County of Somerset*. But the investigations carried out in recent years by the Severn Biological Survey of the Department of Zoology in the University of Bristol have shown that it was mainly to naturalists that the muddy shores of the Bristol Channel offered little attraction, for the marine life is abundant both in species and individuals.

It is true that marine mammals are not conspicuous members of the fauna, but nevertheless a cetacean and a species of seal are regular components of it. Further, the Bristol Channel has the distinction of being the first place where a member of each group was first discovered as a British species.

This paper is believed to contain all the information now accessible on the subject.

PINNIPEDIA. SEALS.

There has been great confusion about the species of seals that have been found, not only in the Bristol Channel, but on the western coasts of all England and Wales. The matter has been critically and most ably discussed by Morrey Salmon (1936) whose paper should be studied by all interested in the subject. Morrey Salmon’s conclusions, with which the present writer entirely agrees, are briefly that the

Grey Seal, *Halichoerus grypus* (Fab.), is the common seal of the west country; that the Common Seal, *Phoca vitulina*, L., is not; and that the unfortunate name 'Common Seal' of *P. vitulina* has led to the uncritical recording of any seal captured or seen as belonging to this species. He says, "So far as the Bristol Channel is concerned, individuals of this species [*H. grypus*] wandered up-channel a hundred years ago or more, as I have shown, and having done so in the intervening period, still do so to-day probably in greater numbers. So far as *P. vitulina* is concerned, between the same two points [Land's End and Anglesey], I think that I have been able to show, equally conclusively, that prior to the end of the Great War there is absolutely nothing tangible to support the oft-repeated statement of its occurrence. There is no specimen in existence so far as I can trace; nothing but hopelessly contradictory 'records,' unsupported and unsupportable."

HALICHOERUS GRYPUS (Fab.) Grey Seal

The first record of the species for the district was made by Bell (1837) who noted that, "In the Bristol Institution is a specimen of a Seal which was taken in the Severn, and for the loan of which for examination I am indebted, amongst many other kindnesses, to my friends Dr. Riley and Mr. Stutchbury; and upon further examination, this also appears to belong to the same species [*H. grypus*]." This specimen cannot now be traced, but it is of interest to note that it was only in 1836 that the exhibition of specimens at the Bristol meeting of the British Association showed the Grey Seal to be a member of the British fauna. The Severn specimen was thus one of the earliest to be recognised. It was, according to the *Report of the British Association* (1837), also exhibited at the Bristol meeting by Dr. Riley.

There are three further instances of the occurrence of the Grey Seal in which the identification of the species is beyond question. One was killed at Barry in 1885, and recorded by Proger (1891, 1913) as *P. vitulina*. This specimen is preserved in the National Museum of Wales and has been examined by Capt. Morrey Salmon and the late Dr. J. J. Simpson who identified it definitely as a Grey Seal. Another specimen, a young animal, was captured alive in the River Usk, at Newport, Mon., on November 7th, 1917. It lived for two years in the Bristol Zoological Gardens, and is now preserved in the Newport Museum (Morrey Salmon, 1936). The last specimen, also a young one, was washed up on the East Moors foreshore at Cardiff

in October, 1934, and sent to the National Museum of Wales (Morrey Salmon, 1936).

There is a number of other recorded occurrences of seals in the Bristol Channel prior to 1920 but, as Morrey Salmon shows, none of them was carefully identified. Most of them were recorded as Common Seals, presumably because it was assumed that any seal must be of that species. There is nothing to show that any of them were *P. vitulina*, and there is every probability that most, if not all, were *H. grypus*. The only example from the old records which has been preserved and can now be examined, the Barry specimen of 1885 mentioned above, proves to be *H. grypus* although it was originally assumed to be *P. vitulina* and was recorded as such.

These records are:—

(1) Smyth (1639) records the "Seale" in his list of fishes found in the Hundred of Berkeley in the early seventeenth century.

(2) Bell (1837) says, "that a large species of seal has occurred, in the same [Severn] or a neighbouring locality, at a remote period, is rendered very probable by the fact that there existed, long ago, a stuffed specimen of such an animal in the hall of Berkeley Castle; and it is certainly not speculating beyond the bounds of reasonable probability, to imagine that this monster might have been a specimen of *Ph. groenlandica* from the neighbouring Severn." All our present knowledge points to the probability of this being a Grey Seal. Bell goes on to quote a letter from Broderip for the information that, according to tradition, this specimen was the skin of the 'great toad' which, so legend said, used to inhabit the dungeons of the castle. The story of the great toad is given by Smyth (1639), and one wonders whether a captive seal may not have given rise to it. Bell also quotes a letter from Ball of Dublin saying, "on my passage to Bristol [presumably to the meeting of the British Association in 1836 when he exhibited the seal crania] I caught, through a telescope, a momentary glimpse of a seal on the Welsh coast, which was probably another specimen." Bell adds "[of the Severn Seal]," meaning *D. groenlandica*, now known probably to be *H. grypus*.

(3) Baker (1851) includes the "Common Seal" in his list of Somerset Mammalia.

(4) Duck (1852) records that "in the spring of 1850 a seal was shot whilst basking on the rocks of the Denny." The Denny is a small island in the Channel off Portishead.

(5) Jones (1865) notes that "the common species of seal (*Phoca vitulina*) has been seen repeatedly upon the English Stones near Berkeley within the last few years." The English Stones, however, are far from Berkeley, and lie between Avonmouth and New Passage, some fifteen miles below that town.

(6) Charbonnier (1906) says that "Mr. Sergeant of Clevedon reports that he saw one ["Common Seal"] that had been shot in Lady Bay, Clevedon, on March 7, 1874."

(7) Proger (1891) records "two 'Common Seals' seen near the Ranny Point [Glam.], 1869. J.S. [= John Storrie]."

(8) Proger (1913) records a specimen, stated to have been a Common Seal, taken at Flat Holm, November 20, 1897.

(9) The same author helped to kill a seal left by the tide in a salmon weir at Oldbury-on-Severn in 1902. (Proger, 1913, and Morrey Salmon, 1936).

(10) Proger (1913) also notes that "a seal" was seen at Southern-down, Glam., on July 14, 1905.

(11) Forrest (1910) saw a stuffed seal in a fishmonger's shop at Weston-super-Mare, and was informed that it was stranded at Weston on May 10, 1906, and was killed with a knife. This specimen cannot now be traced.

(12) Meyrick (1907) records seeing a "full grown Common Seal (*Phoca vitulina*) close to the rocks at high tide" on December 17, 1906, at Clevedon.

(13) Proger (1913) under the heading "*Phoca vitulina*" says, "not many years ago seals of this species frequently visited, at certain seasons, the upper reaches of the Bristol Channel, where they used to follow the run of the salmon, some even going up as far as Gloucester."

(14) Morrey Salmon (1936) records, without details, two or three additional sight records of seals off the Somerset coast received from Mr. Stanley Lewis.

It may be added that off Lundy, at the entrance to the Channel, the Grey Seal is well known to be resident and not uncommon.

PHOCA VITULINA, L. Common Seal

There is a small breeding colony of the Common Seal in the Bristol Channel, and it appears to have established itself only in recent years.

There is not a single definite record of the species prior to 1932, though there is reason to believe that Common Seals were seen as early as 1922. In both these years the present writer saw the animals at the Denny, off Portishead (Matthews, 1932). On November 30, 1934, Mr. H. Tetley and the writer saw a dead *P. vitulina* on the beach at Brean Down, Som. It was considerably decomposed, but the identification by the tooth characters was beyond doubt. The writer also found a newly born Common Seal at Caldicott Pill, Mon. on June 19, 1935. It was certainly a strange freak of fortune that sent the young seal and the writer to this remote spot at the same moment. The unfortunate animal had just been killed by a blow on the head from the heavy stick of a longshore loafer when the writer arrived. This specimen, which was not more than a few days old, is now in the Bristol Museum and Art Gallery (Matthews, 1936). It is of particular interest because it retains the juvenile white coat. Many authors have stated that this first coat is shed before birth, and there is good evidence that frequently this is so. But this specimen shows that, on the contrary, it may occasionally be retained for some time after birth. A considerable length of umbilical cord still attached to the navel showed that this animal was recently born.

Dr. O. H. Wild (1936) records that "a baby specimen of the Common Seal (*Phoca vitulina*) was killed by a salmon fisher half-way between Lydney Docks and Severn Bridge on 1st May, 1935. This specimen was so young that there is reason to think that it must have been bred where it was found. . . . This seal was reported in the Gloucester *Citizen* on May 3, 1935, as a 'Grey Seal'." The identification of this animal was confirmed at the British Museum (Natural History) where the skin is now preserved. It may be noted that, as far as present knowledge goes, the date May 1 is an extremely early one for the birth of young Common Seals, the usual time being at least a month later.

Lastly, the writer saw another Common Seal near the Denny on July 10, 1936.

The origin of this colony is obscure but there is some evidence that the Common Seal is extending its territory southwards from the Scottish coast where it has always been abundant. In support of this theory is the fact that *P. vitulina* bred in 1930 and 1932 in the Dee-Mersey area where it had been known previously only as an occasional visitor (Morrey Salmon, 1936).

There is a widespread belief among fishermen and others that the

seals of the upper Bristol Channel owe their origin to specimens released from the Bristol Zoological Gardens in 1917 when there was a shortage of food for captive animals. But it is known that only one seal, believed, though no record exists, to have been a Common Seal, was released in that year. Unless this specimen was a pregnant female the colony could not owe its establishment to this one individual. The turning out of this animal is the more obscure because in November of the same year the young Grey Seal taken at Newport was received by the Gardens and kept for nearly two years afterwards. On the whole, the southerly extension of the range of the species seems to be the most acceptable explanation of the origin of this colony, unless further evidence to the contrary is forthcoming in the future.

An unidentified seal which may have been a Common Seal was seen at Weston-super-Mare on Saturday, November 25, 1939. It may equally have been a Grey Seal. The *Bristol Evening Post* of the following Monday reported the occurrence as follows: "Anglers at the 'Old' Pier, Weston-super-Mare, had a surprise on Saturday when they saw a young seal, about four feet long on the nearby rocks. A number of fishermen tried to approach it, but it evaded them and slipped off the rocks into the sea, where it remained swimming about for some time in full view of the shore. It is assumed that the seal was attracted to this part of the coast by the number of sprats which are found round Weston at this time of the year. One local boatman complained that his net had been damaged recently by seals."

PHOCA GROENLANDICA, Fabr. Greenland or Harp Seal

Although the Greenland Seal has been frequently seen in the Shetland Islands during the last hundred years, it was from the Bristol Channel that it was first recognised as a British species. The specimens substantiating this record had been lost to view for so long that some doubt has been felt concerning its accuracy. It is due to the perspicacity of Mr. H. Tetley that these specimens were re-discovered and the record authenticated. He writes (Tetley, 1936), "On page 258 of *A History of British Quadrupeds* (1837), Thomas Bell states that ' . . . it is a matter of great satisfaction to me that I am enabled to increase the catalogue of British Seals by the addition of two species, one of which, probably the Long-bodied Seal of Dr. Parsons, has been discovered on the coast of Ireland by Mr. Ball; the other has been taken in the Severn, the remains of two specimens of which are now in the Museum of the Bristol Institution.' Later, on page

270, he states that Dr. Riley exhibited two crania at the meeting of the British Association at Bristol in August, 1836, and that they were afterwards identified as *Phoca groenlandica*. Doubt was afterwards cast on the identification by Robert Ball in a paper 'On the Seals of Ireland (Phocidæ),' *Proc. Royal Irish Academy* 1836-7, Part I, pp. 18, 19 (1837) and he 'expressed his belief that the species was still to be determined.'

"Thomas Southwell, in *Seals and Whales of the British Seas* (1881), mentions the two skulls and says (p. 22): 'These specimens are unfortunately lost.' And in his *Mammals of Great Britain and Ireland*, Vol. I, p. 345 (1904), J. G. Millais, after mentioning the occurrence of these two specimens of the harp (or Greenland) seal, proceeds: 'The skulls have been mislaid and doubt has been cast upon the identification but Bell maintained his point, and the matter will remain in doubt unless the skulls are subsequently recovered.'

"Recently, on going through the osteological collections in the Bristol Museum and Art Gallery, I find that there are two skulls labelled *Phoca groenlandica* which are mentioned in an old catalogue and are the only ones in the collections. There can be no doubt that these are the two mentioned above, and Mr. M. A. C. Hinton, to whom the skulls have been submitted, has confirmed the identification on the skulls.

"It can, therefore, be stated that the first record of the Greenland or harp seal (*Phoca groenlandica*, Fabr.) from British waters was from the Severn in 1836, and that the skulls of these two animals are in the collections of the Bristol Museum and Art Gallery."

However, on referring to the *Report of the Proceedings of the British Association* (1837) a very meagre account of the exhibition of the crania is found, and no mention at all is made of the two skulls from the Severn. The whole validity of the record, therefore, rests upon the writings of Bell, and the existence until a short time ago of the two skulls which, the writer regrets to state, have recently been destroyed as a result of German bombing. The evidence thus appears to be fairly good, but not quite conclusive. It is probable that Baker (1851) had these specimens in mind when he included the Greenland Seal in his list of Somerset mammals.

PHOCA HISPIDA, Schreb. Ringed Seal

There is no definite record of the occurrence of this species in the district, but until recently there was in the collections of the Bristol

Museum and Art Gallery the skull of a Ringed Seal. This may have been from an animal taken at New Passage in April, 1828, and purchased for five shillings by the Bristol Institution to be prepared as a skeleton. This skull was in the old collections of about that date, and there was no other specimen that could have been from that animal. On the other hand, this animal may have been the Grey Seal whose skeleton was seen by Bell, for that skeleton, too, cannot be traced. This skull was recently destroyed, with other valuable material, by German bombs.

ODOBENUS ROSMARE (L.) Walrus

This species is one of the most unlikely of the Pinnipedia to be found in our district, but there is a record, over a hundred years old, of a young specimen being shot far up the Severn. This occurrence is recorded in the *Gloucester Journal* for July 29, 1839, and is quoted by MacGillivray (1839), the account being as follows: "About a fortnight since a strange large animal was observed on the sands of the Severn at Purton, and, as a man went towards it, it retreated towards the water. This emboldened the pursuer, and he soon approached very near to the animal, upon which it turned round and exhibited a countenance of such apparently extraordinary ferocity and disposition to do battle, that the man was glad in his turn to take to flight with pretty considerable speed. He then procured a large duck gun with a man to accompany him, and to lend his shoulder to support the gun while he took aim, and by this means the strange visitant was very soon dispatched. On examination it turned out to be a Walrus or Morse, a well known animal of the seal tribe in the Polar Seas, but which very seldom, we believe, is seen in these latitudes. It was quite young, as it measured only about seven or eight feet in length, while the average length of a full grown Walrus is from twelve to sixteen feet, and some have even measured twenty feet. After its death, it was, we understand, conveyed to Berkeley Castle, where its tusks etc., will probably be added to the other trophies of the chase which are preserved in that ancient baronial fortress." MacGillivray adds, "We cannot but express our regret at the inhospitable reception bestowed upon this young and confiding stranger on the banks of the Severn."

This is the only known occurrence of the Walrus in English seas, all the other British records, about twenty-three, being from Scotland, with the exception of one from Ireland.

Enquiry at the Estate Office at Berkeley has failed to produce any further information about this specimen, or the large seal mentioned by Bell, or the drawing of Smyth's whale mentioned in the next section.

The occurrence of this animal seems to have escaped the notice of most writers on the British mammalia, with the exception of Ritchie (1921), who mentions it in his paper on the Walrus in British waters.

CETACEA. *WHALES AND DOLPHINS.*

Whales, porpoises and dolphins have long been known to occur in the Bristol Channel. John Smyth, writing in 1639, includes the "Porpoise, Thornepole, Jubertas or young whale, alias the herringe hogge . . ." in his list of fishes found in the Hundred of Berkeley. He gives this account of a whale taken within the boundaries of the Hundred in 1620: "If a Sturgeon be taken, in whose several fishings or putts soever, it is the Lord Berkeleis, and by the taker to bee brought to his Castle of Berkeley: Howbeit the lord of custome gives the taker upon delivery of the Sturgeon halfe a marke in money, and a longe bow and two arrows, or half a noble in lieu thereof: But if a whale bee taken (as a younge whale or Jubertas of 22 feet longe was, in the 18th yeare of kinge James, Ao. 1620; whose picture rudely drawne, is in the great hall in Berkeley Castle), that hath noe retribution of right from the lord: not soe much as for making the dray whereon the fish was drawne, whereat were tyed thirty-five yoke of oxen; a fish which yielded an oyle then said and still believed to be very soveraigne and medicinable for aches etc."

It is impossible to know what species of whale this was, but if it really was a young one it may have been a Fin or Sei whale. It is evidently this animal to which Rudge and Charbonnier (1909) refer under the heading of "Grampus or Killer" as having been taken in the Severn in 1639—the date of Smyth's history, but not the date of capture. These authors also state that the Killer is locally known as "Herring hogge," a name evidently obtained from Smyth's list, for no species of the larger Cetacea is sufficiently common to have a local name in this district. The name "herring hog" is of wide occurrence as an old designation for the Killer and may be cognate in origin with the name "porpoise," which is derived from "porcus piscis," hog-fish or fish-hog (cf. German "meerschwein"). On the other hand, it is of interest to note that the Norwegian name for the

Killer is "spek-hugger," which means "blubber-cutter," presumably in allusion to the well-known ferocity of the species and its habit of attacking, killing and feeding upon other kinds of whales, including those much larger than itself. It is possible that "herring hog" is related to the Norwegian word, and that its derivation is not the apparently obvious one.

As for the other obscure names mentioned by Smyth, "jubertas" is defined by the *Oxford English Dictionary* (Murray, 1901) under "jubartes" as "a name given in the 17-18th centuries to species of Rorqual, Finwhale or Finner, especially that found near the coast of New England (Sometimes applied erroneously . . . to the cachalot.) It figures in various works on Natural History, from Klein 1740 to Cuvier 1836, as Balaenoptera jubartes, Baleinoptère Jubarte, Rorqual Jubarte, but the name has disappeared from more recent works." It adds, "as to the origin of the word, J. H. Trumbull in *Fisheries and Fish. Indust. U.S.* (1884), I, 29, says: 'Rondelet . . . gives a figure of a 'Balaena Vera' . . . which the whale-fishers of Saintonge call a Gibbar or Gibbero Dorso, that is 'raised in a hump on which is the fin.' From this provincial name came Gibbartas, Gubartes, Jubart, Jubartes, Jupiter and half a dozen other corruptions, introduced first among mariners.' (Anderson calls gibbar a Basque word)."

The Dictionary makes no mention of the Thornepole, but Owen (1603) says, "the Thornepole is of like forme, biggness and tast, and in all other thinges to the Porpisse; differing onely in having a great round hole in the pole of his head, thoroughe the which he useth to spoute out water in great streames, received in thoroughe the mouth," and "there is of this fish [porpisse], and of the thornepole made store of oyle, though verie stronge and of evill smell." But what species his porpisse and thornepole can be is hard to guess, for he says the porpisse is twelve to sixteen feet long, whereas the porpoise *Phocaena phocaena* is only about five feet long when adult, and further, all Cetacea have blow holes on the top of the head, and the porpisse could scarcely differ from the thornepole by its absence.

Most of the early records of Cetacea in the Channel are quite vague as to species, and Jones (1865), with splendid disregard for zoological affinities, tells us that "porpoises, and even whales, have been taken far above us [Sharpness]; indeed it is upon trustworthy record that a man was killed, while bathing at Worcester, by a swordfish." Duck (1852) says that "about the year 1847, an unusual number of this class [Cetacea] was seen in our channel, comprising the bottle-nose whale,

grampus, and others, many of which were stranded. One of the latter species was taken a little way up the Severn. . . ." Witchell and Strugnell (1892) state that "Mr. A. Jones, of Faversham, informs us that in 1855 or 1856 he saw a whale exhibited at Gloucester."

Another occurrence of a cetacean of undetermined species is recorded by Gatcombe (1875) under the startling title of "Food for Pet Whales." He writes: "Food for Pet Whales. A rather amusing incident concerning a species of Cetacean occurred to me when in Somersetshire a few years since. Being in the neighbourhood of Bridgwater, and reading in a local paper that a young whale had been captured at the mouth of the River Parrett and taken alive to Bridgwater for exhibition, I lost no time in repairing to that place to make enquiry, in the hope that I might be the means of having it forwarded to one of the tanks of the Zoological Gardens, Regents Park, but found—not much to my surprise—that it had been dead and cut up for some days. However, upon asking at a house if they had not a young whale exhibiting, I was answered in the following words: 'Ee, zur, an a vine lusty young vish he was, playful as a kitten—lived a week and growed a voot—till the vools chucked en wie barley male!'"

The latest stranding of a whale of unknown species seems to be that recorded by Harmer (1925) at Roose Point, Glam., on August 12, 1924; its length is given somewhat vaguely as "14 to 23 feet." However, as a stranded whale usually attracts some attention, later if not sooner, there is a considerable amount of reliable information about the specimens which have turned up from time to time in the Bristol Channel.

BALAENA GLACIALIS, Bonnaterre Biscay Right Whale

Baker (1851) includes the Greenland Whale (as *Balaena mysticetus*) in his list of Somerset mammals, but this is an obvious mistake because the species has never been found in British waters. His record no doubt rests upon an occurrence of one of the large *Mystacoceti*. It is quite possible that the Right Whale, *B. glacialis*, has come into the Channel within historical times, but Baker's record more probably refers to one of the Rorquals.

BALAENOPTERA PHYSALUS (L.) Fin Whale

Charbonnier (1906) says, "several specimens of Rorqual have from time to time floated up the Bristol Channel or been stranded on the

Somerset coast . . ." but no details are available of any such strandings beyond what are set out below.

A female whale of this species was washed ashore dead at Littleton Pill on January 15, 1885. It was towed up the Pill to Elberton brickyard, and on January 17 was examined by Wilson (1885 *a, b*), who identified it and gave a description and photograph in the *Proceedings* of this Society. The animal lay in the Pill about a fortnight, during which special trains were run by the Midland Railway Company, and thousands of people saw it. Wilson adds, "the body was claimed by the Lord of the Manor, and also by the agent for the Crown, as 'flotsam and jetsam.' The latter carried the day, and sold the carcase by public auction, when it was knocked down to Messrs. Kent and Cotterell, artificial manure manufacturers, of Bristol, for the sum of £40." On January 29 it was towed down the Estuary and up the Avon by tug, and then by six horses to the works at St. Philip's Marsh. "It was floated ashore on a high tide and enclosed within a hoarding, and exhibited to the public for a fortnight. The animal was then cut up, the flesh being converted into animal manure, whilst the skeleton was preserved as an anatomical specimen." Wilson gives a fairly complete description of the animal, and says that no cause of death could be found. His photograph shows the whale lying on its back, the anterior end of the body being much distended by the gases of decomposition. The tail end, however, appears considerably emaciated. Careful investigation has failed to find any trace of the skeleton as an anatomical specimen, and from information supplied by the person who was foreman of the manure works at the time, it is believed that the bones were used for manure at a later date. Wilson's statement that the bones had been preserved must have been due to some misunderstanding, or to an intention which was never fulfilled.

There has lately been some correspondence in the local press from people who can remember seeing this whale. One correspondent (Moss, 1940), who was twelve years of age at the time, refers to "the stench emanating from the monster, which, when I saw it, had two traction engines attached to it, and had thus been drawn up the Pill to dry land."

BALAELOPTERA BOREALIS, Lesson Sei Whale

A male 48 ft. 5 in. long was stranded at Portskewet on February 17, 1925; it was first seen in the Severn on February 15 swimming up-

stream. The first eighteen feet of the animal, including the head and part of the thorax with the flippers, weighing six and a half tons, was conveyed to the British Museum (Natural History) where a plaster cast was prepared from it (Harmer, 1927). Though the Sei whale has been caught in some numbers by the whaling companies that worked in northern British waters, only four specimens, of which this is one, have been stranded on the British coasts in the twenty years from 1913 to 1932 inclusive. Harmer (1927) gives references to notices of this stranding which appeared in the *Field*, *Illustrated London News* and *Times*.

BALAELOPTERA ACUTO-ROSTRATA, Lacepède Lesser Rorqual

Proger (1891) quotes 'W.N.P.' [Dr. W. N. Parker]: "a specimen of the Rorqual (*Balaenoptera rostrata*), about 35 feet in length, was stranded off Portmadoc [Glam.] two years ago, and its skull and some other parts of the skeleton are now in the Biological Museum of the University College. Another individual of about the same size was killed off Pwllheli last July, but its skeleton, I believe, was not preserved. I am indebted to Professor G. Hartwell Jones, for information with regard to these specimens."

On August 4, 1915, a specimen 26 ft. long was stranded at Rhossili in the Gower peninsula of Glamorgan (Harmer, 1916), and another, 14 ft. 7 in. long, was washed up at Port Eynon nearby on May 30, 1926 (Harmer, 1927).

HYPEROODON ROSTRATUS (Muller) Bottle-nosed Whale

Several examples of this species of whale have been found in the Channel. Baker (1851) includes the species in his list of Somerset mammals but he gives no details. Duck (1852) mentions that bottle-nosed whales were among the Cetacea stranded in the channel about 1847. One, probably a young male, was stranded at Aust in October, 1840. It was 22 feet long, and its skeleton is now mounted and on exhibition in the Bristol Museum and Art Gallery, having luckily survived a recent mishap with only slight damage. A water-colour drawing of the animal made on the spot in 1840 by W. H. Baily was, however, unfortunately lost after surviving for just over a century. The measurements of the animal, noted on the drawing, were published by Gray (1866), and in transcribing them, an error has crept in. As the original drawing is no longer available, it is as well to point out now that the dimension given by Gray, "Length from end of tail to anterior

part of dorsal fin, 9 ft. 8 in.," should read, "Length from anterior of dorsal fin to blow-hole, 9 ft. 8 in.," according to the legend on Baily's drawing. This error of transcription was disconcerting because the length from the end of the tail to the posterior part of the dorsal fin is given as 7 ft. 0 in., which, by subtraction, gives a length of 2 ft. 8 in. for the dorsal fin. But the dorsal fin is listed separately as 1 ft. 2 in. in length. This correction will now make the matter clear. Gray (1844) also gives a figure of this specimen in his account of the "Zoology of the Erebus and Terror."

On November 7, 1860, a female whale of this species was stranded near Knightstone, Weston-super-Mare. It was, according to Knight (1902), about 18 ft. long, and was alive when it came ashore, "but it soon died. It was exhibited for several days, and its complete skeleton now hangs in the Weston Museum." The skeleton is still on exhibition in that place. Gray (1866) gives the measurements of this whale, as furnished to him by a Mr. Crotch. He states that it was taken at Weston-super-Mare and exhibited at Bristol, but no confirmation of this latter assertion has been found. An error has crept into these measurements, too; the total length is given as 26 ft. 0 in., evidently a misprint for 20 ft. 0 in. Gray also refers to this specimen as the one "which was shot at Weston-super-Mare," and if that is correct, Knight's remark that "it soon died" is not surprising. Charbonnier (1906) mentions this whale, referring to Compton (1882), but neither author gives a definite date. Rudge and Charbonnier (1909) mention both the Aust and Weston specimens, giving the incorrect date of "about 1857" for the latter.

Proger (1891 and 1913) records one "stranded near the mouth of the Rumney River [Cardiff], November, 1868: a portion of the skull is preserved in Cardiff Museum."

Witchell and Strugnell (1892) say that "within the last twelve years [i.e., between 1880 and 1892] two whales have been stranded in the county [Glos.], and we are credibly informed that the last one was a beak-whale, or bottle-head. . . ." No details have been found concerning this alleged occurrence.

On November 23, 1914, a male about 22 ft. long was stranded at Blue Anchor, Som. (Harmer, 1915), and another male 16 ft. 9 in. long at Burry Port, Carmarthen, on the opposite coast of the Channel, on September 14, 1918. This latter Harmer (1919) regards as "probably on the Southward migration."

PHOCAENA PHOCAENA (L.) Common Porpoise

"Porpoises," which are assumed to be of this species, are frequently seen in the Channel, and occasionally their dead bodies are washed up on the shore. Sometimes they go far up the Severn or its tributaries Smyth (1639) records the porpoise from the Hundred of Berkeley, Jones (1865) (also quoted by Witchell and Strugnell, 1892) said that porpoises were seen frequently in small numbers at Sharpness; Proger (1891) quotes "J.S." [John Storrie]: "frequently seen in Bristol Channel, near Penarth. I have seen five of this species in the pool where Temperance Town Bridge [Cardiff] now is on one occasion." He reproduces this in his 1913 paper, and adds, "porpoises were seen off Penarth three years ago." One, captured in the River Avon at the Horse-shoe Bend on September 22, 1910, is now in the collections of the Bristol Museum and Art Gallery.

Other records of strandings are:—Rhossilly, Glam., May 23, 1920, 5 ft. 9 in.; Porthcawl, Glam., March 22, 1926, 4 ft. 8 in. (Harmer, 1927); Porthcawl, July 1, 1927, 4 ft. 8 in.; Combe Martin, Devon, November 6, 1931, 3 ft. 0 in.; Combe Martin, August 16, 1932, 4 ft. 9 in., female; Weston-super-Mare, October 23, 1932, 5 ft. 0 in. (Fraser, 1934).

Porpoises were very common in the upper Bristol Channel in the summers of 1938 and 1940.

ORCINUS ORCA (L.) Killer

The Killer, often called the "grampus," a name which strictly belongs to another species, Risso's Dolphin *Grampus griseus*, has been recorded in the Channel on a number of occasions. Several times there appears to have been a remarkable visitation by numbers of the animals in company. Duck (1852) mentions the unusual numbers of Cetacea "comprising . . . the grampus and others" which were seen in the Channel in 1847. Jones (1865), in a footnote to his paper, says, "since the above was written (in the month of August, 1863) several grampuses (*Phocaena orca* of Cuvier) have been captured in the Severn, near this place [Sharpness], and one within three miles and a half of Gloucester. They are supposed to have been in pursuit of a large shoal of salmon, as the unusual number of forty-five was taken on the same day at Minsterworth, near the place where the last named was captured. The largest of these was twenty-two feet and the smallest nine feet in length." His date "August, 1863" evidently refers to the occurrence of the whales, for his paper was read to the Cotteswold

Society at Cheltenham on March 4, 1863. Witchell and Strugnell (1892) also mention this visitation, referring to Jones' paper, but misquoting the volume number as "VIII" instead of "III" and the page as "14" instead of "140." This record must be accepted with reserve. Young Killers, soon after birth, about November or December, are about seven feet long, so that by August they would be expected to be considerably over nine feet, the size of the smallest of those mentioned above. It is impossible now to say what these animals were; the larger ones may have been Killers, and the smaller some species of dolphin, but it may be noted that the term "grampus" is not confined to the Killer, but is also used for Risso's Dolphin, as mentioned above, and perhaps for other species as well.

In the following year another school of these whales visited the Channel. Clarke (1864) writes, "on 21st of March [1864] ten of these huge creatures came up the Parrett to within five miles of Bridgwater following the course of the river, or three miles in a straight line; they then returned about four miles down the river or to about half a mile below the village of Comwich, where they were all captured by means of harpoons and spears. Two of them were brought up to Bridgwater and exhibited: these I saw; one of them was 23 ft. 3 in. long, measured in a straight line, and 16 ft. round at the largest part; the other was very much smaller, being but 13 ft. long. Of the other eight, one is said to have been rather longer than the larger of the two which were brought to the town, but not thicker; another still smaller than the smaller of these, being but 11 or 12 ft. long; the rest are described as varying in length from 18 to 21 ft." Gray (1866) also refers to this school, telling us that "agriculturalists have found that they [stranded Cetacea] are good manure, and as soon as any of them, especially of the smaller kinds, are caught or thrown ashore, they are carried inland and buried, as was the case with a school of *Delphinus Orca* lately taken near Bridgwater." He also wrongly mentions the date of the capture of these whales as "March 24" instead of "21." The Bridgwater Killers are mentioned by Lydekker (1895) and Charbonnier (1906), the latter adding that "Mr. Sergeant of Clevedon saw two whales, probably of this species, killed in Little Harp Bay, Clevedon, on October 17th, 1866."

Knight (1902) states that "dead . . . grampuses have been found on the shore at Weston-super-Mare and . . . have been seen alive by the fishermen," and Baker (1851) includes the species in his list. Proger (1891), quoting information given by J. Storrie, records "one

stranded near the mouth of the Rumney River [Cardiff] a few years ago." He reproduces this statement in his later list (Proger, 1913) and adds, "a fact which I can corroborate."

GLOBIOCEPHALA MELAENA, Traill Black Fish or Pilot Whale

Baker (1851) includes this species in his list of Somerset mammals, but gives no details. It has not been recorded since, though it is not an uncommon British species.

LAGENORHYNCHYS ALBIROSTRIS (Gray) White-beaked Dolphin

This species, which is particularly common in the North Sea, has occurred several times in the Bristol Channel. In 1924 a female nine feet long was stranded at Brean, Som., on November 11, and another, 7 ft. 9 in. long, at Watchet, on November 25. Both these specimens were aged, as shown by the complete loss of the teeth from the first and the loss of the majority from the second. In the latter, a large fish bone was found attached to the mucous membrane of the throat, which was inflamed. The bone was identified as the dentary of a large whiting. (Harmer, 1927).

In the *Daily Mirror*, No. 9,271, for August 11, 1933, there is a photograph of "holiday makers examining with interest a dolphin which became stranded on the sands at Burnham-on-Sea, Somerset. It was nine feet in length." The picture shows only the ventral surface of the animal, so that identification is difficult, but it is almost certainly either the White-beaked or the Common Dolphin. It is included here as probably of this species because of its length—nine feet. Harmer (1927) gives the adult length of this species as nine to ten feet, but he found only three Common Dolphins, out of forty-eight, over eight feet long.

On June 27, 1936, a specimen, apparently of this species, about 5 ft. long, was stranded at Portishead. A good photograph of it was published in the *Bristol Evening World* for that date, when it was described as a shark "of the blue-nosed variety."

This species, once regarded as a rarity, is now known to be one of the commoner British dolphins, though it has not often been met with on the west coasts.

TURSIOPS TRUNCATUS (Montagu) Bottle-nosed Dolphin

The first known British examples of this species were two taken near Berkeley and sent to John Hunter, who described them some time

later, in 1787, as "*Delphinus delphis* of Linnaeus or Bottle-nosed whales." He gives an engraving of the smaller specimen and says, "it was caught upon the sea coast, near Berkeley, where it had been seen several days, following its mother, and was taken along with the old one, and sent up to me whole, for examination, by Mr. Jenner, Surgeon, at Berkeley. The old one was eleven feet long." But he also states on another page, "I had one sent to me by Mr. Jenner, Surgeon at Berkeley. It was about eleven feet long." Evidently some error has occurred, unless both specimens were sent, for his engraving is of the smaller animal; and, indeed, it is likely that Jenner sent the smaller specimen rather than the eleven foot one. Perhaps the bones only of the larger one were sent. Hunter also adds, "the milk [from the larger one, the mother], which was tasted by Mr. Jenner and Mr. Ludlow, Surgeon, at Sodbury, was like rich Cow's milk to which cream had been added," an observation which holds good for the milk of many species of Cetacea, as the writer can confirm.

The remains of these specimens still exist in the Hunterian collection of the Museum of the Royal College of Surgeons, and are described by Flower and Garson (1884) as specimens Nos. 3003 and 3004, with references to Hunter's original paper. Bell (1837) refers to these specimens of Hunter's, and his figure of the species is almost certainly a reduced copy in reverse of Hunter's engraving. Gray (1866) also briefly refers to these animals and the repository of their skeletons.

Baker (1851) includes this species in his list, but there are no further records until the present century when there were several strandings in Glamorgan. These were: a 9 ft. specimen at Port Eynon on January 3, 1920 (Harmer, 1921); a 6 ft. specimen at Aberavon on April 23, 1928; a male about 10 ft. long at Porthcawl on September 5, 1932; and a female and young about July 1, 1927, at the same place. Of the last, Fraser (1934) writes "there is one very young specimen. . . . It measured 3 ft. 10 in. and was evidently the newly-born calf of the female stranded at the same time and place; the parent animal was 11 ft. in length. A piece of the jaw of the young animal was sent to the [British] Museum and it was observed that the teeth had not cut the gum."

DELPHINUS DELPHIS, L. Common Dolphin

There is no definite record of this species for the district, beyond its inclusion, without details, in the list of Somerset mammals by Baker (1815).

In conclusion, the writer wishes to record his thanks to Mr. Tetley, who, for some years past, has collaborated in the study of the local mammals and has assisted in many ways in compiling this account of the seals and whales of the Bristol Channel. Acknowledgment is also due to the Leverhulme Trust for assistance towards the publication expenses of this paper.

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Fumeroles, Hot Springs and Geysers

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FUMEROLES

THE emission of hot gases and steam, particularly steam, which is such a marked feature of volcanic eruptions continues long after the volcano has passed into the dormant or dying-out condition. The points of emission are known as fumeroles or, when sulphurous vapours accompany the steam, by the Italian word *solfatara* (French equivalent *soufrière*), after the Solfatara, near Naples, a wide shallow crater, the greatest diameter of which is about a mile, which was last in eruption in 1198.

Knowledge of fumeroles is in large measure based on St. Claire-Deville's¹ and Fouqué's² study of those of Vesuvius and Etna. Fouqué has established by the analysis of numerous samples of gases and by measurements of temperature that the chemical composition of the substances deposited at fumeroles depends on the temperature. The hottest fumeroles, with temperatures of 100°-500° C. (acid fumeroles), deposit metallic sublimations, especially of iron and copper combined with chlorine, and these are often remarkable for their vivid colours. When the temperature is lower (40° to 100° C.), fewer substances are deposited. Such (alkaline) fumeroles contain ammonia and deposit sulphur, while in cold or nearly cold fumeroles—*mofettes*—carbon dioxide is the chief product. This is given off in consider-

Full accounts of the subjects described in this paper will be found in many text books of Geology, as for instance in A. Geikie's *Text Book of Geology*, 4th ed., p. 313, and A. de Lapparent's *Traité de Géologie*, I, p. 474.

A few references are given under 'Lobeck' to Professor A. K. Lobeck's *Geomorphology* (1939), McGraw-Hill Book Company.

It will be noted that both Centigrade and Fahrenheit scales are employed in stating temperatures, and both yards and meters when alluding to size and distance.

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¹ St. Claire-Deville, C., *Mémoire sur les émanations volcaniques*. *Bull. Soc. Geol. France*, Ser. 2, XIV, 1856-7, p. 256.

² Fouqué, F., *Recherches sur les phénomènes chimique qui se produisent dans es volcans*. *Theses Fac. Sci. de Paris*, 1866.

able quantities at many points both in volcanic and non-volcanic districts, as for instance at the Grotto del Cane near Naples, where it was formerly the cruel custom to introduce a dog and render it insensible. The weight of the gas may cause it to accumulate round the fumerole and, as it has no colour, smell or taste, it may form a trap with a fatal effect on animals. Thus, in the so-called 'poisonous valley of Java' even such large and powerful animals as tigers have been found suffocated. The 'poisonous valley' is a depression about 100 yards long, and at the bottom is a hollow about 18 feet in diameter, where CO_2 accumulates to a depth of about $2\frac{1}{2}$ feet and is sufficient to prevent the decomposition of animals which have been suffocated. 'Death Gulch,' in the Yellowstone Park, U.S.A. is a similar case, and in it bears, deer and squirrels have perished. Much more often the rising CO_2 is likely to become dissolved in water and form carbonated springs. The various vapours and gases given off by fumeroles may further have a strongly corrosive effect on rocks and may cause great damage to vegetation. The temperature of fumeroles is much greater than that of hot springs and may reach 1200°F . Steam is vastly the most abundant substance given off but hydrochloric acid, carbon dioxide, sulphuretted hydrogen, nitrogen, oxygen, ammonia and hydrofluoric acid are recorded as often present.

Fumeroles abound in many parts of Iceland (*Pl. 8 c*), especially in the area south of Reykjavik, while in the Yellowstone Park (*Pl. 10 c*), there are said to be over 3,000. Lava streams often give off steam for long periods after their emission and so do deposits of hot ash as in the 'Valley of 10,000 smokes,' a product of the great eruption of Katmai, Alaska, in 1912. Submarine fumeroles also exist: thus, the central volcano of which the Lipari islands form the remnant affords as its last trace of activity a submarine fumerole which discharges great quantities of CO_2 and H_2S from an opening about 25 feet below the surface of the water, the rising bubbles of gas producing the appearance of boiling.

HOT SPRINGS

Hot springs, though commonest in regions of active volcanoes, are very common in old volcanic districts such as Auvergne, where several discharge as much as 1,800 to 2,000 cubic metres a day. Among the more noted of central Europe are those of Baden Baden (86)*, Carlsbad Sprudel (75), Wiesbaden (68), Aachen (56), Vichy (35 to 45). They

* The figures indicate the Centigrade scale.

occur also in places like Bath where it is necessary to go as far back in geological history as the Silurian before any considerable indications of volcanic action are to be found anywhere in the district.

The hot springs of Carlsbad which rise through a potash granite are, it is somewhat surprising to learn, particularly rich in soda.

While hot springs have been important medicinally since very early times, in recent years they have been used in many places for economic purposes, as in Tuscany and other parts of Italy and at 'The Geysers' (so called) 75 miles N. of San Francisco where a great amount of deep-seated steam is tapped by boring. In Iceland the hot water is used for swimming baths, heating greenhouses, cooking and washing clothes (*Pl. 7 b*). Hot springs may be due to several causes. In old volcanic regions descending surface water may become heated by contact with still hot lava or by mixing with vapours therefrom. Sometimes the heat may be derived from an intrusive mass of igneous rock which has not reached the surface. Chemical action and radioactivity may in rare cases have contributed to the high temperature. Hot springs tend to be plentiful in regions where the rocks are much folded as in the Appalachians and in the western mountain ranges of the American Union. The explanation may be that in such rocks the temperature has been raised by crushing or that their fissured character renders easier the movement of water from the heated interior of the earth. Sometimes hot springs contain substances not found in the surface rocks, this presumably indicating a magmatic origin for the water. Springs may also have the temperature raised from local causes such as vegetable decay or the oxidation of pyrites.

Many hot and cold springs have the water saturated with carbonate of lime which is deposited as tufa or travertine when the surface is reached. A classical example of this is afforded by the deposits at Tivoli and other places near Rome; at San Filippo a deposit some 30 feet thick was formed in 20 years. The material may form an excellent building stone, Rome is in fact mainly built of travertine. At Hammam-Meskhoutine, Constantine, Algeria (*Pl. 7 c*) and at the ancient baths of Hieropolis, near Smyrna, travertine has been deposited in great cascade-like masses, that at Hieropolis being probably the finest in the world and upwards of 350 feet high and 3 miles wide. The travertine at Hammam-Meskhoutine was deposited by water issuing at a temperature of 95° C. The hot springs of Vichy deposit great masses of concretionary travertine.

A hot spring region in central Arkansas, U.S.A.³ is unique in occurring in a non-volcanic region, and in the fact that it is not associated with any zone of fracture. The springs have a temperature of about 140° F., and the heat is thought to be derived from an igneous intrusion not exposed at the surface.

Boiling springs and pools are found in many old volcanic districts, particularly in the Yellowstone Park where a variety of types occurs. They grade from hot pools which do no more than steam, through others which quietly boil and simmer, to pools which boil strongly and steadily. A further stage is afforded by pools which boil and bubble somewhat violently or spurt and splash. A final type, which comes nearest to a true geyser, is the spouting spring which suddenly ejects, perhaps at intervals of only a few minutes, a great mass of hot water and steam (*Pl. 7 a*).

A peculiar but widely distributed development of hot springs is illustrated by the boiling mud pans known in the Yellowstone Park as 'paint pots.' They arise when a boiling pool has a water supply insufficient to compensate for loss through evaporation, particularly if the water rises through soft or weathered rock. The water then becomes replaced by a mass of bubbling mud which may sometimes rise in great blister-like bubbles which swell till they burst (see also p. 258). Such mud volcanoes are very widely distributed, being found at Girgenti in Sicily, near Modena, in the Crimea, at Baku on the western shore of the Caspian, in California, at Cartagena in Colombia, in Java and in various other places.

GEYSERS

Lastly, we have the true geysers,⁴ which are rare phenomena practically confined, so far as is known, to three districts of the world, —Iceland where they were first described, the Yellowstone Park where quite the finest development is to be found, and New Zealand. References to other slight manifestations of geyser activity are given on p. 262. After a short general account of geysers, those of the three chief areas will be described separately.

The term geyser is from the Icelandic word to gush. They are eruptive fountains of hot water and steam, and have been termed

³ Bryan, K., The Hot Springs of Arkansas. *Journ. Geol.*, XXXII (1924), p. 449.

⁴ For a general account of geysers see A. C. Peale, The World's Geyser Regions, *Pop. Sci. Monthly*, XXV (1884), p. 494.

water volcanoes. Their eruptions may sometimes occur at nearly regular intervals of time, but much more frequently the intervals are very irregular. The water may be discharged from a wide opening several yards in diameter, as in the Variable geyser of the Yellowstone (*Pl. 11 c*), or the opening may be only a foot or two across. The column of water may, particularly in the case of geysers with a wide mouth, be only a few feet high or may be thrown to a height of 150 to 200 feet (far higher in the case of the great Waimangu geyser of New Zealand), (*Pl. 12 c*). While the jet of water generally plays steadily and straight, it may sometimes be jerky and irregular, composed of several minor jets and discharged obliquely. The amount of the discharge varies indefinitely, some geysers throw out only a few dozen gallons, 'Old Faithful' is said to discharge 10,000 to 12,000 gallons at each eruption, while the discharge of the Great Waimangu geyser has been estimated at 800 tons.

Geysers commonly erupt from a cone of material deposited by themselves. This may form a rim a foot or two high round those with very wide mouths, or may, as in the case of 'Old Faithful' and the Great Icelandic geyser (*Pl. 8 b*), be a low cone with a depression in the middle at the bottom of which is the crater, or may build up a steep-sided cone. The material of the cone varies in accordance with that of the country rock, being siliceous sinter (geyserite) when the rocks are igneous, calcareous when, as at Mammoth, the rocks are limestone. In the Yellowstone Park all the active geysers, or at any rate all the more familiar ones, are in the siliceous regions, the rock being generally rhyolite. But in the Mammoth region the calcareous cones of extinct geysers occur. Some extinct geysers have no opening at the top of the cone as, after eruption has ceased, the passage has been gradually filled up by the material deposited by the water.

ICELAND⁵

While innumerable fumeroles, hot springs and boiling pools occur in Iceland, it seems that at the present time there is only one locality — 'Geyser' — where true geysers occur. This is situated about 25 miles N.E. of Reykjavik. Here there are two geysers, the Great Geyser and a much smaller one, about 100 yards to the S.W., the Strokhr (*Pl. 8 a*), which is said to have come into existence after the

⁵ Thoroddsen, Th., *An Account of the Physical Geography of Iceland* (1914), in *The Botany of Iceland*, London. Also *Explorations in Iceland*, *Nature*, XXX, May to Oct., 1884, pp. 563 and 584.

earthquake of 1789 and has several times ceased to play owing to later earthquakes, subsequently resuming action.

The Icelandic geysers were known for many years before those of any other part of the world were discovered, and have been studied, and the nature of their action discussed, by several authors including Bunsen, Des Cloizeaux and Tyndall (see p. 259).

The Great Geyser, which erupted at intervals of about half-an-hour in 1772, has for many years been very irregular, many days often elapsing between two outbursts. Each eruption is commonly preceded by several spasmodic efforts. The column of water which is surrounded by a cloud of steam may be 9 or 10 feet in diameter and may rise to 150 feet, the height oscillating. Bunsen and Des Cloizeaux record a temperature of 260° F. in the pipe, and the latter estimated that 160 cubic meters of water are thrown out at each eruption.

Reference has already (p. 254) been made to a spouting spring which, from an opening in the river bank near the Great Geyser, was ejecting great masses of boiling water and steam at the time of the writer's visit in 1937 (*Pl. 7 a*). Such a spouting spring has claims to be grouped as a geyser.

THE YELLOWSTONE PARK, U.S.A.⁶

Statements vary as to the number of geysers in the Park, but about 200 is the usual estimate. Nearly every year a new geyser appears or an old one gives out. In any case, they are many times as numerous as those of the rest of the world put together. The number of hot springs and fumeroles is said to exceed 3,000. When the Park is entered from the N., the Mammoth Hot Springs area is commonly the first one where a stay is made. Here the rocks are Jurassic and Cretaceous limestones, and while there are abundant hot springs depositing calcareous tufa there are now no active geysers. Geysers are at the present time only found when, as in the main

⁶ 1883. Holmes, W. H., Report on the Geology of the Yellowstone Park, *U.S. Survey of the Territories*, 12th An. Rep., Washington.

1891. Hague, A., and W. H. Weed, Hot Springs and Geysers of the Yellowstone Park, *5th Internat. Geol. Congress*.

1912. Weed, W. H., Geysers, *U.S. Dept. Int.*

1935. Allen, E. T., and A. L. Day, Hot Springs of the Yellowstone Nat. Park, *Carnegie Inst., Washington, Publ. No. 166*.

There are several semi-popular accounts including H. M. Cadell's *The Yellowstone and its Geysers*, *Scottish Geog. Mag.*, VIII (1892), p. 233, and A. Geikie's *The Geysers of the Yellowstone*, in *Geological Sketches at Home and Abroad* (1882), p. 235.

geyser basins further S., the country rock is siliceous, and then the deposit is geyserite or siliceous sinter.

The calcareous deposits at Mammoth are most beautifully seen as a series of terraces on the slopes of a plateau about 1,000 feet high overlooking the valley. These terraces (*Pl. 10 a*) have been formed from below upwards and, as the building continues, the openings through which the hot water emerges also rise so that the water always issues above the highest terrace. The water as it runs down the hillside has deposited tufa so as to form a series of basins with rims thickly encrusted with carbonate of lime (*Pl. 11 b*), the overflow from the upper basins supplying those below. A dozen or more such terraces, each with a level surface and steep slope, may be passed over as one ascends the hillside. The temperature of the springs is said to vary from 80° to 165° F. Although there are no active geysers, there are mounds of tufa in various stages of decay suggestive of extinct ones. Liberty Cap (*Pl. 9 c*), which has a height of about 50 feet, is the cone of an extinct geyser; it is far taller than any other cone in the whole Park.

The preglacial age of the tufa terraces of Terrace Mountain, a few miles S. of Mammoth, is shown by the fact that ice-borne boulders rest on them, while moraines are buried under some of the newer deposits.

The chief geyser basins are situated on a plateau about 1,000 feet higher than Mammoth Hot Springs. There are 3 of these, the Norris geyser basin, and the Upper and Lower geyser basins. Each forms a down-faulted block of the Yellowstone plateau, and many of the hot springs and geysers are situated on lines of fault (see map in Lobeck, p. 128).

The Norris basin is about 20 miles S. of Mammoth. The 'basin' where the chief fumeroles and geysers are situated measures about 300 by 200 yards. Numerous fumeroles are scattered over it (*Pl. 10 c*) and there are several interesting geysers, two of which, the 'Whirligig' and the 'Constant,' erupt at intervals of a few minutes and illustrate how varied the behaviour of geysers may be. During the writer's visit, the 'Constant' blew off every 3 or 4 minutes; after an eruption the water was quiet for about 2 minutes, then ebullition began and got stronger and stronger till the geyser went off with 3 or 4 jets, throwing to a height of about 12 feet. The mouth of the 'Constant' is about 10 or 12 feet wide, and were it smaller the eruptions would doubtless be more violent. The 'Whirligig' has a longer interval

and each eruption blows off in a series of spurts from the centre, accompanied by jets shot violently out at a low angle, with a sound precisely like that of a locomotive blowing off steam.

About 8 miles S. of Norris is the 'Mammoth Paint Pot,' a basin measuring about 60 by 40 feet with a raised rim about 4 or 5 feet high. It is full of a firm whitish paint-like mud formed of decomposed rhyolite which kept gently boiling and plopping at a number of points. The 'Paint Pot' is situated near the commencement of the Lower Geyser Basin which, followed by the Upper, occupies a wide area near the Firehole River. Nearly all the most famous geysers are in this part of the Park. Along much of the river banks are slopes or sometimes terraces of sinter dotted over with geysers and hot pools from which streams of hot water pour down to the river. Some of the geysers are situated down by the water's edge. The complete lack of any sympathetic activity on the part of neighbouring Yellowstone geysers is commonly a remarkable feature.

'Old Faithful' (*Pl. 9 b*) is the most famous of the Yellowstone geysers. It has built up a low, gently sloping mound about 15 feet high and discharges from an opening measuring about 4 feet by $1\frac{1}{2}$, i.e., like all the geysers which play to a considerable height, it has a comparatively small mouth. It steams continuously, but when about to erupt after loud rumblings it first shoots out about 4 considerable jets of water and then discharges a regular and continuous column to a height of about 125 to 150 feet. The ejection takes 2 to 3 minutes. During the time that 'Old Faithful' has been under observation, its period has changed from a regular one of 60 minutes, to an irregular one of 70 to 90 minutes.

The eruption of the 'Daisy' was very similar to that of 'Old Faithful' and nearly as impressive. As an instance of a different type of eruption, Cadell's account of the 'Great Fountain' may be quoted: "After preliminary jumpings the water rose to a height of 50 feet in an irregular conical mass made up of a bundle of jets each apparently trying to jump the highest."

On the rare occasions when the Grand Geyser erupts, it is said to play for about 30 minutes, while in some others the whole is over in less than a minute.

Several of the geysers have built up large sinter cones; this is specially the case with geysers like the 'Castle,' 'Rocket,' and 'Grotto,' which spurt out violently and irregularly. There are several remarkable groups of associated geysers such as the 'Giant' group and the

'Lion' group. The 'Giant' (*Pl. 9 a*), which has built up a cone 8 or 9 feet high, has a mouth only about 4 feet wide, while the 'Giantess,' which erupts at intervals of a few weeks, has an enormous mouth about 25 feet wide. Illustrations are given of two other Yellowstone geysers, the Sponge (*Pl. 11 a*), which has built up a considerable symmetrical cone, and the Lakeside (*Pl. 10 b*), a small symmetrical cone.

Algal growths⁷ are a great feature of the Upper Geyser Basin. Sometimes they grow in the run-off from the geyser, yellow in the hottest, red in somewhat cooler water. The most wonderful feature is, however, afforded by the algal pools, especially the 'Emerald Pool.' This is about 20 yards wide and one can see into it to a depth of about 25 ft. The whole interior is lined with algae of a vivid green, while the margin is formed of a mass of sinter coated by yellow algae. The beauty of the whole is perfectly marvellous.

Geysers and hot springs are found in a number of parts of the Yellowstone which the writer was unable to visit. Although new geysers occasionally appear, a gradual diminution of activity is probably indicated by the numerous extinct cones and wide tracts of sinter. On the other hand, while it is a common feature for a geyser to cease to erupt temporarily or to all appearances permanently, this may merely indicate that a new channel for the ascent of the hot water has been formed, possibly owing to the blocking of the old one by deposits.

Recent studies of the Yellowstone geysers have shown that by far the greater part of the water is of surface origin, the heat on the other hand being of deep-seated origin and derived from magmatic steam.

THE NATURE OF GEYSER ACTION⁸

The nature of geyser action and, in particular, the intermittent character of the eruptions have been studied by several authors, particularly Bunsen and Des Cloizeaux who, in 1846 made a series of experiments and observations on the Great Geyser of Iceland. They ascertained that the temperature of the column of water in the pipe

⁷ Davis, B. M., *The Vegetation of the Hot Springs of the Yellowstone Park*, *Science*, n.s. (1897), p. 145.

⁸ Bunsen, R., *Recherches sur les Rapports intrinsèques des Phénomènes pseudovolcaniques de L'Islande*, *Annales de Chimie et de Physique*, Ser. 3, XXXVIII (1853), p. 213.

Des Cloizeaux, *Comptes Rendus*, XXIII, 1846.

Tyndall, J., *Heat a mode of Motion*, 4th ed. (1870), p. 122.

increases with the depth, being far above the normal boiling point of water, 212° F., in the lower part of the pipe which they sounded to a depth of 80 feet. The superheated water does not boil at the normal temperature, being kept liquid by the pressure of the overlying column of cooler water. The temperature, however, gradually rises, being perhaps assisted by the entry of large bubbles of steam which lift the column, causing a slight overflow and hence reduction of pressure. The water in the hottest part of the column, being now heated above the boiling point for the diminished pressure, flashes into steam and the whole column of water and steam is violently shot out.

In the modern accounts of geyser action stress is laid on the existence of considerable cavities and fissures in which steam accumulates, affording an explanation of the varied behaviour of individual geysers.

It has been the custom to stimulate the eruption of certain geysers by adding an alkaline substance such as soap. This impedes the circulation of the water by rendering it somewhat viscous and so checks the escape of steam. The heat is thereby held down and the water at some distance below the top of the column is more quickly brought to the boiling point.

In the case of the Yellowstone Park geysers, the drilling of holes⁹ has given much information as to the temperature of the water in the cavities. In the Norris basin new vents broke out when steam at high pressure was tapped. The system of passages indicated by the bores proved to be a more complex one than that commonly shown in the earlier diagrams and consisted of an irregular main conduit of moderate depth connected by ramifying channels with basins and cavities extending in all directions. There are usually a number of preliminary surges before the eruption gets fully under weigh. The jet may die down for a few moments and then start again in full vigour.

NEW ZEALAND¹⁰

The geyser region of the North Island of New Zealand which, in

⁹ Fenner, C. N., Yellowstone Park Borehole Investigation, *Journ. of Geol.*, XLIV (1936), p. 225.

¹⁰ von Hochstetter, F., and A. Petermann, *The Geology of New Zealand*. Auckland, 1864.

Martin, J., The Geysers, Hot Springs and Terraces of New Zealand, *Pop. Science Rev.*, n.s., III (1879), p. 366.

Cadell, H. M., A Visit to Mt. Taravera, *Scottish Geog. Mag.*, XIII (1897), p. 246; and A Visit to the New Zealand Volcanic Zone, *Trans. Edin. Geol. Soc.*, VII (1899), p. 183.

Grange, L. I., The Geology of the Rotorua-Taupo Subdivision, *New Zealand Geol. Surv.*, n.s., Bull. 37, Rotorua-Taupo.



a



b



c



c



b



a



a



b



c



a



b



c



a



b



c





point of interest, follows next after that of the Yellowstone, was greatly affected by the eruption of Mt. Taravera in 1886. It shows most of the features found in the Yellowstone, such as fine geysers of which there are four groups. The most remarkable of these geysers, the Wairoa, used to throw up a column of water 200 feet high, but is now dormant. No geyser at present active is as spectacular as the great Icelandic geyser and some of those of the Yellowstone. There are also very numerous hot springs and fumeroles, but the special fame of the New Zealand geyser area lay in the 'Pink (*Pl. 12 a*) and White' sinter terraces. These, which were about 100 ft. high, were quite similar in character and method of formation to those of Mammoth Hot Springs but probably exceeded in beauty any of those of the Yellowstone. The great eruption of 1886, however, completely destroyed them.

The eruption of 1886 was the cause of the coming into existence of the Great Waimangu geyser (*Pl. 12 b* and *c*), unique among geysers for its size and for the character and magnitude of its eruptions.¹¹ It was discovered in January, 1900, and before the end of 1904 had ceased to play. Its activity was thus limited to between 4 and 5 years. The crater, which measured 150 by 80 feet, was generally full of black muddy water. Eruptions at first took place approximately every 24 hours, but were very irregular in character and amount of discharge. When most active, it hurled water and black mud estimated at 800 tons to a maximum height of perhaps 1,500 feet. In contrast with the violent phase was one when the geyser played lightly and intermittently for 5 or 6 hours at a time. The intervals between the eruptions were rarely more than 30 hours. For more than 4 years after its discovery, Waimangu was in active eruption, but during July and August, 1904, it remained quiescent for nearly two months. After this period of inactivity it recommenced its eruptions with unabated and indeed often increased energy, and so continued till 31 October, 1904, when, with the exception of a feeble eruption the following day, it ceased to play and has remained in a dormant or extinct condition. (Quoted almost verbally from Maclaren.) In view of the intense activity of Waimangu, so greatly exceeding that of any other geyser, doubt has been expressed as to whether the term geyser is applicable.

Geysers are not absolutely confined to the 3 chief regions: in

¹¹ Maclaren, J. M., The Source of the Water of Geysers, *Geol. Mag.* (1906), p. 511.

N. America they are found in California (Lassen Park and Salton Sea), and Nevada¹² where thick siliceous deposits and jets of hot water are described, but it may be doubted whether the phenomena merit the term geyser. In Central America the boiling lake of Dominica and the water volcano of Guatemala afford representatives of geyser action (Lobeck¹³), while de Lapparent records that in Salvador fumeroles, hot springs and mud volcanoes are found, but these again can scarcely be termed geysers; there is also a record of a geyser in Japan, near Tokio.¹⁴ A South American locality¹⁵ is Copacoya on the Rio Loa in northern Chili. Here small geysers, mud vents, pools of boiling water and mounds of geyserite occur. Fouqué¹⁶ describes hot springs of the nature of geysers at San Miguel in the Azores. Lastly, there is a geyser region in Tibet.

A peculiar siliceous deposit of Old Red Sandstone age found at Rhynie¹⁷ in Aberdeen and containing plant remains has been regarded as the deposit of a geyser.

DESCRIPTION OF PLATES

Pl. 7 (b) is from a photograph by Miss M. Reynolds taken in 1937; *Pl. 7 (c)* is from one by Professor F. Francis taken in 1905; *Pl. 11 (b)* is from one by the late W. H. Banks; *Pl. 12 (a)* is from a photograph bought about 40 years ago from Messrs. Dunscombe of Bristol; *Pl. 12 (b)* and *(c)* are from photographs which appeared in a New Zealand daily paper in 1902 or 1903. The remainder of the illustrations are from photographs by the writer, those of the Yellowstone having been taken in 1924 and those of Iceland in 1937.

Pl. 7 (a) Spouting Spring near the Great Icelandic geyser.

(b) Washing clothes at a hot spring near the Great Icelandic Geyser.

(c) Cascade-like mass of travertine deposited by hot springs at Hamman Meskhoutine, Constantine, Algeria.

¹² Nolan, T. B., and G. H. Anderson, The Geyser Area near Beowawe, Eureka Co. Nevada, *Amer. Journ. Sci.*, 5th ser., XXVII, p. 215.

¹³ P. 126.

¹⁴ Honda, K., and T. Terada, On the Geyser in Atami, *Phys. Rev.*, XXII (1906).

¹⁵ Rudolph, W. E., The Rio Loa of Northern Chili, *Geog. Rev.*, XVII (1927), p. 553.

¹⁶ Fouqué, F., *Comptes Rendus*, LXXXI, p. 1,361.

¹⁷ Mackie, W., The Rock Series of Craigbeg and Ord Hill, Rhynie, Aberdeenshire, *Trans. Edinb. Geol. Soc.*, X, pt. 2 (1914), p. 205.

- Pl.* 8 Iceland.
- (a) The Strokkur geyser in eruption.
 - (b) The low, slightly steaming cone of the Great Geyser.
 - (c) Fumeroles near the Great Geyser.
- Pl.* 9 Yellowstone Park, U.S.A.
- (a) Cone of the 'Giant.'
 - (b) 'Old Faithful' in eruption.
 - (c) Liberty Cap, Mammoth Hot Springs. This cone of an extinct geyser is the tallest in the Yellowstone Park.
- Pl.* 10. Yellowstone Park, U.S.A.
- (a) Cleopatra terrace, Mammoth Hot Springs.
 - (b) Lakeside geyser, Yellowstone Lake.
 - (c) Fumeroles at the Norris Geyser Basin.
- Pl.* 11. Yellowstone Park, U.S.A.
- (a) Sponge geyser.
 - (b) Pulpit terrace, Mammoth Hot Springs.
 - (c) Variable geyser.
- Pl.* 12 Geyser district of North Island, New Zealand.
- (a) The Pink terrace, Rotomahana.
 - (b) The Waimangu geyser quiescent.
 - (c) The Waimangu geyser in eruption.

Geology of the Bristol District

LIST OF PUBLICATIONS FOR THE YEARS 1929-1940

By E. W. SEAVILL

(Read in title, March 1, 1941)

THIS list of publications is a continuation of those previously published by the late Mr. J. E. Livingstone in the *Proceedings of the Bristol Naturalists' Society*, 4th Ser., Vol. III, pt. iii, 1913 (for 1912), pp. 119-133, 4th Ser., Vol. IV, pt. i, 1914 (for 1913), pp. 82-98, and 4th Ser., Vol. VII, pt. i, 1929 (for 1928), pp. 58-70.

The Bristol District is defined for geological purposes as being "bounded on the west by the Severn and Bristol Channel, and on the north by a line drawn from Tite's Point on the Severn to the Stroud Valley. On the south it may be regarded as including the Mendip Hills and on the south-east as bounded by the Cretaceous outcrop of Salisbury Plain. Farther to the north its eastern boundary is ill-defined but may be drawn across the hilly country from Bradford-on-Avon through Badminton to Stroud."

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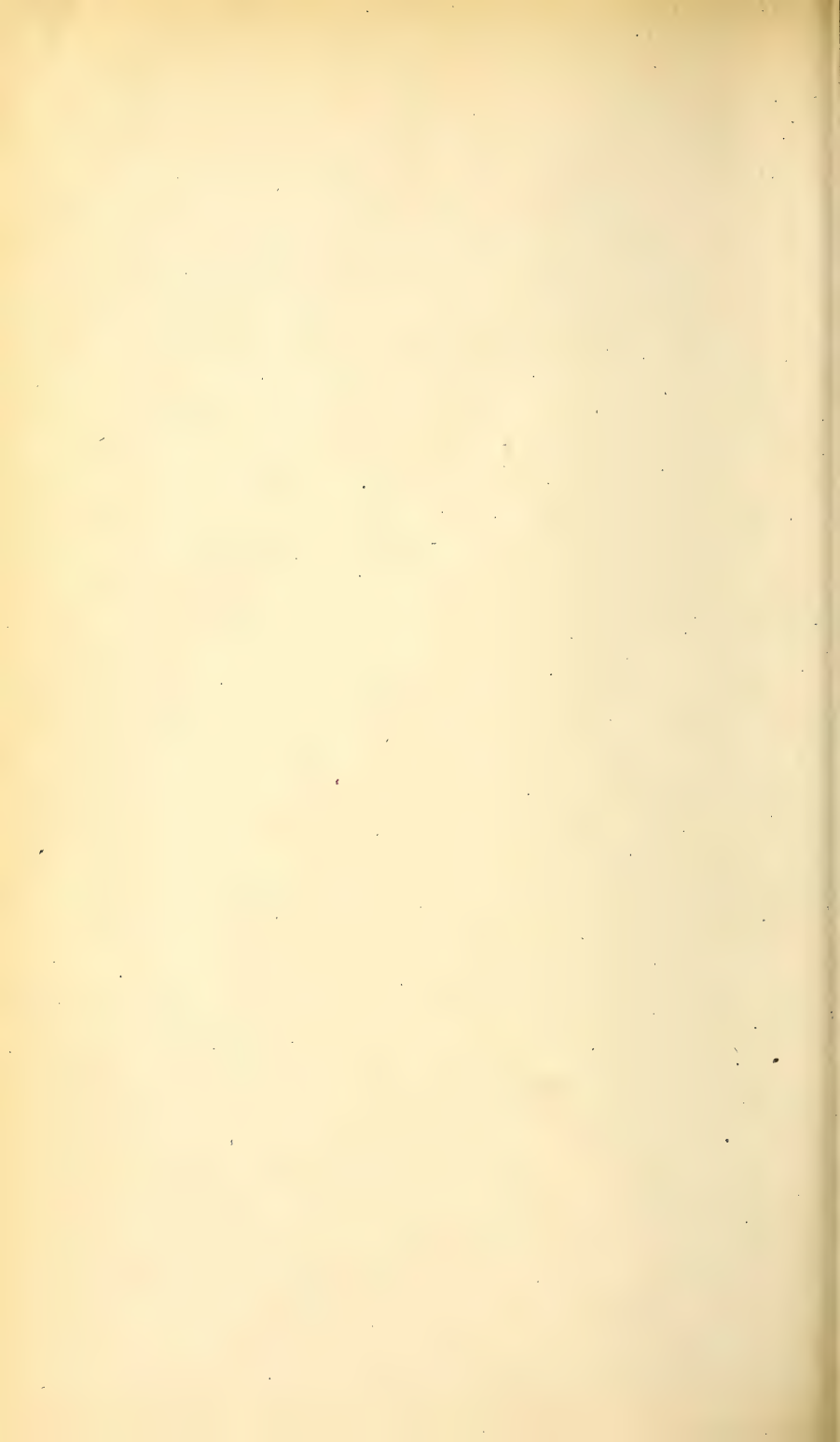
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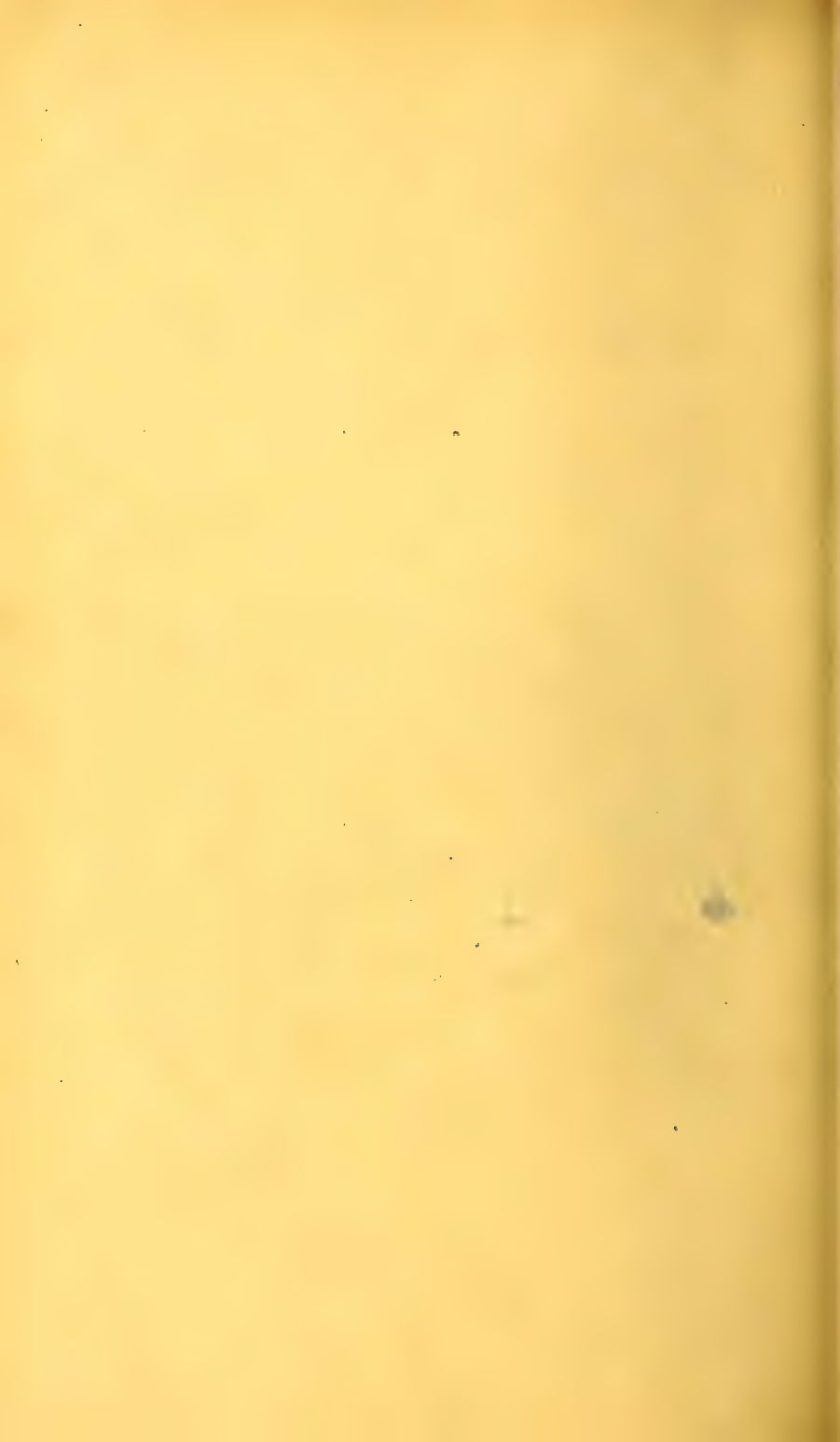
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PROCEEDINGS

OF THE

Bristol Naturalists' Society

EDITED BY H. W. TURNER, M.A., F.G.S.

ASSISTED BY A COMMITTEE



"Rerum cognoscere causas."—Virgil.

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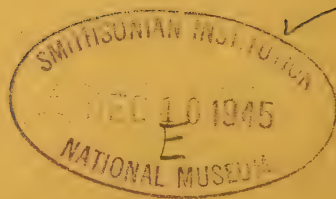


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THE UNIVERSITY,
BRISTOL, 8.

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Prof. C. M. YONGE, D.Sc.	

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As a measure of economy, the full list of members is not printed.

New Members

A = Associate. B = Botanical Section. F = Field Section.
G = Geological Section. O = Ornithological Section.

1941

	Cook, Rev. A. H.	..	Edgefield, Walton St. Mary, Clevedon, Som.	<i>G.O.</i>
A.	Gait, R. P.	..	51 Howard Road, Henleaze, Bristol	<i>O.</i>
	Shaw, Miss D.	..	38 Logan Road, Bishopston, Bristol	<i>B.</i>
	Stubbs, R. L.	..	Hill View, Ham Lane, Olveston, Glos.	<i>B.</i>
	Thomas, G. W.	..	Northcote House, Clifton Park, Bristol, 8	<i>B.G.</i>

1942

	Blewitt, W. H., L.D.S...	H.M.S. <i>Cabot</i> , Bristol, 7	<i>O.</i>
	Denty, Miss P. M.	.. 23 Downs Park West, Bristol, 6	<i>F.O.</i>
	Fleming, Miss M. L.	.. 23 Downs Park West, Bristol, 6	<i>F.O.</i>
	Fountain, Miss K.	.. 13 All Saints' Road, Clifton, Bristol, 8	<i>F.</i>
	Reynolds, Miss M.	.. 13 All Saints' Road, Clifton, Bristol, 8	<i>F.</i>
	Strothers, Miss G. M., B.Sc.	68 Woodstock Road, Bristol, 6	<i>B.O.</i>
	Taylor, G. H.	.. 107 Sylvan Way, Sea Mills, Bristol	<i>F.</i>

REPORT OF COUNCIL

to 31 December, 1941

DURING the past year your Council has maintained the policy adopted in 1939 in that it considers the continued existence of the Society to be of paramount importance. To this end meetings have been held as frequently as possible and by re-electing the Officers and Committee, under the Presidency of Professor Macgregor Skene, the administration has been ensured and stabilised. The only change was that Mr. F. W. Evens was elected Hon. Auditor in place of the late Mr. Charles Bartlett.

It is with deep regret that we record the death of five members, namely, Mr. W. Melville Wills, who was a Life Member, Professor H. S. Hele Shaw, one of the few Honorary Members, Mr. Roger Ford, Dr. Rose Bracher, and Mr. F. N. Reed, all Ordinary Members. The last two were active members of the Society and their presence—especially on the Botanical side—will be sadly missed. Dr. Rose Bracher will be remembered for her clear exposition on the occasions when she lectured to the Society.

Owing to black-out conditions, meetings were held on Saturday afternoons in the months of February, March and November, whilst in October the Society reverted to its normal practice and met in the evening of the first Thursday in the month. The Annual General Meeting was held on a Saturday afternoon in January.

The Annual Field Meeting, organised by the Field Section, was held on 14 June in the Eastern Mendips under the leadership of Mr. H. O. Edmonds. An interesting feature was that two plants new to the district were found by Mrs. C. Sandwith.

Once again Council would stress the importance of all members continuing their connexion with the Society so that in the era of post-war reconstruction the organisation will be complete and ready for a creative forward movement.

M. DORIS HILEY, *Hon. Secretary.*

The Hon. Treasurer in Account with the Bristol Naturalists' Society

Dr. RECEIPTS AND PAYMENTS FOR THE YEAR ENDING 31st DECEMBER, 1941. Cr.

1940 £ s. d.	To Members' Subscriptions:— Life Ordinary: 1939 " 1940 " 1941 Associate: 1940 " 1941 Junior: 1941 Total Subscriptions Sale of Publications Grants towards <i>Proceedings</i> Advertisement in <i>Proceedings</i> Grant from Field Section towards cost of Bookbinding Sundries Interest on Deposit in Post Office Savings Bank 1940 do 1941 Subscriptions to Sections per contra Balance from last Account 188 19 11	£ s. d.	£ s. d.	By Subscriptions:— Ray Society <i>Zoological Record</i> S. W. Naturalists' Union <i>Proceedings</i> , 1941 Stationery and Printing Postages, etc., Hon. Treasurer " Hon. Editor Fire Insurance Meeting Expenses Cheque Books Witherby's <i>British Birds</i> Librarian's Expenses Rent Bookbinding Subscriptions to Sections paid over Balance to next Account:— Cash at Bank Deposit at Post Office Savings Bank Cash in hands of Hon. Sec. 215 15 2 £270 14 5
58 10 0	3 11 0	3 11 0	3 11 0	
13 0 0	69 6 8	69 6 8	8 8 7	
17 6	4 4 7	4 4 7	6 19 2	
72 7 6	6 18 1	6 18 1	2 11	
12 9 7	1 10 0	1 10 0	1 10 0	
17 14 0	1 1 0	1 1 0	1 5 0	
	2 0 0	2 0 0	4 0	
	1 1 0	1 1 0	1 1 0	
	1 10 4	1 10 4	1 17 10	
10 0	2 0	2 0	1 0	
1 7			5 0 9	
103 2 8	90 8 8	90 8 8	32 4 3	
25 7 0	25 7 0	25 7 0	22 15 0	
60 10 3	24 19 3	24 19 3	141 19 5	
	45 6 0	45 6 0	66 16 9	
	2 19 0	2 19 0	6 19 0	
			215 15 2	
			£270 14 5	

Audited and found correct.
ERNEST H. COOK, } Auditors.
F. W. EVENS, }

Bristol, 15 January, 1942.

A. H. PEACH, Hon. Treasurer.
9 January, 1942.

Memo: There are accounts outstanding relating to 1941 as follows:—
Cost of Printing *Proceedings* 150 12 3
Hon. Secretary's Postages, etc. 3 8 7

154 0 10

LIBRARIAN'S REPORT

1941

THE evacuation of the Library, the beginning of which was reported in the last Annual Report, has been continued during 1941. Approximately a half of the total contents of the Library has now been dispersed to some half-dozen private houses in country districts near Bristol. The Society is very much indebted to the following for so kindly agreeing to store books: Mr. F. G. Hudson of Dursley, Mr. W. J. Latham of Backwell Farleigh, Mr. G. S. Maunder of West Town, Mr. Alfred R. Robinson of Backwell, and Col. Turner of Tockington. A number of books is also being stored by the Hon. Librarian. Indeed, the disposal of a still greater proportion of the Library has been limited, not by a dearth of generous offers to take books, but by the difficulties of transport which, owing to the shortage of petrol, have been great. The Society is particularly grateful therefore to Dr. L. H. Matthews and Mr. H. H. Davis for their considerable help in this respect. Arrangements have been made to ensure that the books so dispersed shall be covered by the existing Fire Insurance Policy.

The books removed from the Library (probably amounting to several tons in weight) include runs of some ninety separate journals, as well as a number of the more valuable single volumes. The opportunity has been taken of compiling an accurate catalogue of all books leaving the Library. This proved to be a task of no little difficulty in view of the frequency with which in the past some Societies have changed the title of their publications, the inconsequent appearance of supplements, appendices, and the like, often bearing no relation in subject matter or paging to the regular journal, the haphazard grouping of unrelated parts within the same binding, and the fact that in some cases the title on the binding bears almost no relation to the contents. But although the work is rather more formidable than was anticipated, the pile of index cards is growing steadily.

Further progress has been made with binding. The whole of the three series of memoirs of the Belgian Natural History Museum—28 large volumes—have been bound at the Society's expense, while the Geological Section has been responsible for the cost of binding 6 volumes of the *Geological Magazine* and 6 volumes of the *Q.J.G.S.*, and the Ornithological Section has paid for the binding of 2 volumes of *British Birds*.

The Society is indebted to Mrs. Charles Bartlett for the presentation of books. The fifth and last volume of Witherby's *Handbook of British Birds* has now appeared, and the Library has been considerably enriched by the purchase of a complete set of this excellent production. The *Zoological Record*, 1939, and Bristowe's *The Comity of Spiders*, Vol. II (Ray Society Monograph) were received by subscription, the latter forming (together with Vol. I published in 1939) a work of exceptional interest to the naturalist. Journals have been received as usual from the Geological, Entomological, Botanical and Ornithological Sections.

Publication of the magazine *Countryside* (received by subscription) and of the Devon Bird Watching and Preservation Society's *Report* (received by exchange), which was in both cases suspended at the outbreak of war, has now been resumed.

Several Societies on the Exchange List, which have for varying periods failed to send copies of their publications, have been written to, with the result that many gaps on the Library shelves have now been filled.

Notice has been received that 18 copies of the *Proceedings* for 1940 have been destroyed by enemy action in transit to U.S.A. It is not known whether any American publications have been lost on the way here as it is believed that some American Institutions are postponing despatch of journals to this country until after the war.

There is always a certain demand for copies of back numbers of the *Proceedings*, of which, in the case of some issues, the stocks are very low. This is particularly true of vol. V, part 5 (1922), and vol. VI, part 1 (1923). The Society does not possess a single reserve copy of either of these issues. This means that if the Society wishes to obtain by exchange a complete set of back numbers of the publication of another Society, it does not possess a complete set of its own *Proceedings* to offer in return. If any members are considering handing over their stock of *Proceedings* for Paper Salvage, or have any copies of previous issues to spare, it is earnestly hoped that they will remember the value of these back numbers to the Library.

H. GORVETT, *Hon. Librarian.*

REPORT OF BOTANICAL SECTION

1941

THE Section has held ten meetings, but the attendance has scarcely been up to the average. Material brought in has been plentiful, mainly of the typical Bristol flora supplemented by a few rarer plants from other counties, e.g. :—

Elatine hexandra from Devon,

Pimpinella major and *Pimpinella Saxifraga* var. *dissecta* from Bedfordshire,

Seseli Libanotis from Cambridgeshire, and *Alchemilla alpina* from a station in N. Wales.

Crepis setosa has re-occurred in the district, and also the white form of *Borago officinalis*.

On the invitation of Prof. Skene, the University gardens and greenhouses have supplied an opportunity for a more intensive study of plants during their growth, which was used and much appreciated.

We regret the loss by death of Dr. Rose Bracher and Mr. Frank Normanton Reed.

ETHEL M. E. BELL, *Hon. Secretary.*

REPORT OF GEOLOGICAL SECTION

1941

At the Annual Meeting on 25 January Professor Gordon was elected President and Professor Whittard Vice-President; Mr. Ashby, Mrs. Marsden and Mr. McMurtrie were re-elected Hon. Secretary, Hon. Treasurer and Hon. Auditor respectively; Sir Lewis Fermor, Mr. Hudson, Professor Reynolds, Dr. Stanley Smith, Mr. Turner and Dr. Wallis were appointed Committee members. Two short papers followed: on the topic, "Geology in School," Mr. Gunner outlined practical methods of fostering an interest in the subject among children; Dr. Wallis spoke on "Exposures of Millstone Grit in Clifton," indicating the significance of temporary sections which he has recorded in the *Proceedings* for 1939.

A lecture given on 15 February by Dr. S. W. Wooldridge, entitled "The Land Forms of South-East England in relation to those of the West Country," offered illuminating suggestions concerning the origin of some of the major scenic features of our district.

At the fully attended Open Meeting on 15 March, Mr. F. H. Edmunds of the Geological Survey lectured on "Water Supply from Underground Sources." It was gratifying that Professor Reynolds and Mr. Tutchter were present on this occasion as it was the 40th anniversary of their election to the Society.

On the evening of 7 May a party led by Dr. Stanley Smith studied the zonal sequence in the Carboniferous Limestone of the left bank of the Avon Gorge.

Another auspicious anniversary, Mr. and Mrs. Tutchter's diamond wedding on 6 June, was marked by a presentation expressive of members' sentiments of affection and esteem. It is a pleasure to record here our appreciation of Professor Gordon's generosity, which enabled the presentation to take a most fitting form. Appropriately enough, the object of the excursion led by Mr. Fry on 7 June was to examine the Lower Lias and Inferior Oolite of the Radstock district—an area noted for the non-sequences proved among its strata by the work of Mr. Tutchter and Professor Trueman.

On 5 July a visit was made to Stinchcombe Hill, where Mr. Hudson conducted the party to exposures of Upper Lias and Inferior Oolite and demonstrated features of structural interest in a most skilful manner.

Aspects of the economic geology of the Bristol region were illustrated in an excursion which Professor Gordon led in the Bitton area on 6 September.

On 19 October an exhibition of members' specimens and other exhibits was held in response to the appreciation expressed of the exhibition arranged by the Geological Departments of King's College and Bristol University last year. Thanks are due to those who contributed to the success of this experiment.

A subject of popular interest was provided on 15 November by Mr. Donovan, who, in a lecture on "The Geology of 'G.B.' Cave," presented an admirable account of the remarkable Mendip cavern recently discovered and explored by members of the University Speleological Society.

By the death of Mr. F. N. Reed the Section has lost a particularly staunch member, and we offer his brother, Mr. W. N. Reed, our deepest sympathy.

The resignations of Messrs. A. G. Bakewell, H. C. Bishop, M. M. Phillips and Miss L. Priscott are regretted. As new members we welcome the Rev. H. A. Cook, Miss B. Lankshear and Messrs. J. C. How and G. W. Thomas. Membership now stands at 64.

D. F. ASHBY, *Hon. Secretary.*

REPORT OF ORNITHOLOGICAL SECTION

1941



DESPITE war-time difficulties this Section has completed yet another useful programme. At the five meetings held a variety of interesting lectures have been heard, and it is to be regretted that comparatively few of the 66 members have been able to attend regularly.

In *January* a talk of particular local interest was given by Mr. A. C. Leach who, in speaking on "Bird-life of the Bristol Avon," gave a valuable account of birds to be found along some fifteen miles of the river between Keynsham and the sea at Avonmouth. Special reference was made to the breeding of Ravens and Peregrines in the Gorge, and to such exceptional visitors to the docks area as Glaucous and Iceland Gulls. A mammalian subject was chosen for the *February* meeting, when members were privileged to hear a highly informative lecture by Dr. L. H. Matthews on the "Life-history of Bats." Wing structure was especially dealt with and drawings were shown to illustrate how this differs from that of birds and the extinct Pterodactyl. With regard to vision, Dr. Matthews explained that bats appear to rely little on sight, and that even when blindfolded are able to fly clear of obstructions and take food on the wing with ease. Various British species were described, also the large Fruit Bats of Australia and the blood-sucking Vampires of South America. In *April* more was learnt of local birds when Mr. R. P. Gait gave an illustrated talk entitled "Reminiscences of a Bird Photographer." Among a fine series of slides were some showing bird-life in the Bristol area, while others were the result of expeditions to mid-Wales, Dorset and the Scilly Isles.

The Rev. F. L. Blathwayt spoke at the *October* meeting, and his lecture on "Somerset Duck Decoys" contained much both of ornithological and historical interest. Details were given on the construction and working of a decoy, and figures quoted to show the rapid decline of the industry in the British Isles during the last half-century. On the former practice of taking ducks in Somerset the lecturer stated that of the nineteen known decoys within the county all are now out of use. The last meeting of the year was held in *November* when members heard a review of the new *Handbook of British Birds*. This was given by the President, who, in explaining the general plan of the work, paid tribute to Mr. B. W. Tucker's detailed and accurate notes under the section "Field Characters." Of the many excellent plates, special attention was drawn to those of birds in flight—Hawks, Ducks, Waders and Skuas—by Messrs. G. E. Lodge and J. C. Harrison. Reference was also made to maps—showing either migration routes, the distribution of local species, or the breeding stations of such maritime birds as the Gannet and the Fulmar Petrel.

Field work has only been possible on a small scale, individual members having made occasional visits to the Severn and the North Somerset reservoirs. The usual census of breeding Herons at Brocklêy and Banwell was, however, carried out, and thanks are due to Mr. H. W. Neal for undertaking the task at both Heronries.

Membership shows a slight decrease—perhaps unavoidable in the circumstances, and since the early part of the year the Section has been unfortunate in losing the active co-operation of several of its keenest supporters—among them Mr. A. C. Leach and Mr. W. R. Taylor, who, with the Clifton College personnel, are temporarily in Cornwall.

H. H. DAVIS, *Hon. Secretary.*

Account of the Annual and General Meetings

1941

THE 78th Annual Meeting of the Society was held in the Botanical Department of the University of Bristol on Saturday 18 January, when the President, Professor Macgregor Skene, was in the Chair. The reports of the Honorary Treasurer, Honorary Librarian and Honorary Secretary were read and adopted. All the Officers and Committee were re-elected in accordance with the accepted war-time policy of the Society.

The President gave an address on the Floras of the latter part of the 18th century, tracing the early history of *Flora Londinensis*, the *Botanical Magazine* and the *Botanical Register*.

Instead of the Annual Dinner, on Saturday 1 February, at the 609th General Meeting, Dr. A. H. Campbell gave a lecture on "Backcloth to a Clove." Professor Macgregor Skene was in the Chair and the meeting was held in the Wigglesworth Library at the University.

The 610th General Meeting was on Saturday 1 March, when, with the President in the Chair, Professor Doris L. Mackinnon of King's College, London, gave a lecture on the Sand-fly Menace and traced the history of the researches on kala-azar in India.

The 611th General (Field) Meeting was held on 14 June in the Eastern Mendips and was led by Mr. H. O. Edmonds.

The 612th General Meeting was held on Thursday 2 October, when Mr. W. F. Grimes gave a lecture on "Burn Ground Barrow, Northleach: a Cotswold Burial Place of Three Ages." The President was in the Chair.

The 613th General Meeting took the form of an Exhibition Meeting and was held on Saturday 1 November, in the Senior Botanical Laboratory of the University of Bristol with Professor Macgregor Skene in the Chair.

M. DORIS HILEY, *Hon. Secretary.*

Bristol Botany in 1941

BY CECIL I. SANDWITH

(Received, Feb. 13, 1942. Read in title, March 26, 1942)

THE ordeal through which our city passed in the winter of 1940-41 has had some temporary effect upon its flora. The site of houses demolished on Redcliffe Hill was quickly colonized by *Epilobium angustifolium*; a little crop of fodder beans (horse beans, *Vicia Faba* var. *equina*) germinated in the cracks of Bristol Bridge; and botanists may soon find other less familiar flowers among the ruins, which have been cleared less quickly than those of some other cities. After a mild autumn, cold winds and severe frosts in April and May ruined the fruit crops which were so much needed, and other plants which had come on well suffered severely. But in spite of our difficulties the year 1941 is memorable for the addition of two native species to our flora: *Carex laevigata* Sm., which was discovered on June 14 on the annual summer excursion of this Society to the Mendips and Stoke Lane Valley; and the grass, *Glyceria declinata* Bréb., which has been found in both W. Gloucester and N. Somerset and may have been overlooked in past years.

Papaver Lecoqii Lam. Roadside on Beacon Hill, Mendip, S., C. and N. Sandwith.

Stellaria Holostea L. A pretty form with the petals deeply laciniate with narrow lobes was found by Mr. Ivor Evans near Keynsham, S. In this form, which has occurred elsewhere in England, the lobes themselves are sometimes so deeply divided that each petal has four narrow subequal segments in its upper half.

Hypericum dubium Leers. Valley at Damery Bridge, G., N. Sandwith.

Poterium Sanguisorba L. A curious 'hen and chicken' form of proliferation, with numerous small heads of flowers rising on peduncles from main heads, was found by Mr. Ivor Evans on a roadside at Failand, S.

Sorbus torminalis (L.) Crantz. Mr. J. P. M. Brenan writes that there is a specimen of this from Burrington, S., coll. W. Watson, in the herbarium of the Imperial Forestry Institute at Oxford.

Peplis Portula L. Damp track in the Stoke Lane Valley between Edford and Nettlebridge, S., C. and N. *Sandwith*.

Epilobium angustifolium L. About eight stems of the lovely form with white flowers were found with the typical plant in a cut-down wood on Beacon Hill, Mendip, S. They were shown to me by Mr. Edward Maggs, the owner of the land.

E. obscurum Schreb. $\times$ *parviflorum* Schreb. Ditch by the road between Chew Stoke and West Harptree, S., C. and N. *Sandwith*. Confirmed by Mr. G. M. Ash, and apparently the first Bristol record of this hybrid.

Lonicera Caprifolium L. For some yards along a hedge in a lane on Backwell Hill, S., where it flowered last June. It was first noted here in the spring of 1923 by Mr. Colin Trapnell, when only the leaves were seen.

Leontodon hispidus L. An interesting form with black, glabrous or subglabrous involucre, and scapes glabrous or glabrescent in the upper half, occurs in Max Bog, Winscombe, S. It is not the var. *glabratus* (Koch) Bischoff (*L. hastilis* L.) which has glabrous leaves in addition, and has been found in Britain only as a casual.

Centunculus minimus L. Plentiful with *Peplis* on a damp track in one spot in the Stoke Lane Valley between Edford and Nettlebridge, S., C. and N. *Sandwith*. This is very rarely noted in N. Somerset, and the only previous Bristol records were from Leigh Woods, S., and Syston Common, G.

Myosotis sylvatica (Ehrh.) Hoffm. A single patch by the stream in the damp, wooded Stoke Lane Valley near Edford, S., Ivor Evans. Other recent N. Somerset records, not previously published in these notes, are from the Chew Valley between Chew Magna and Pensford, and from Limeridge Wood above Tickenham, see H. S. Thompson in *Journ. Bot.*, 1934, p. 320. The species cannot be regarded as certainly native in any of these localities, of which Mr. Evans' seems much the least open to suspicion.

Veronica Anagallis-aquatica L. By stream in the Stoke Lane Valley, S.

Orobanche elatior Sutton. On *Centaurea Scabiosa* near Hawkesbury, G., 1939, Ivor Evans. This is one of the rarer species in our flora, being known to persist only on the same spur of the Cotswolds near Weston above Bath, S., T. H. Green.

Mentha arvensis L. var. *agrestis* (Sole) Sm. In cultivated land on Mendip near Cranmore Tower, S., *C. Sandwith*. The variety was found in this neighbourhood by Sole himself who wrote, "This mint grows in corn-fields about Mendip Hills, Shepton Mallet, and Frome" (*Menthae Britannicae*, p. 34, ann. 1798, and quoted in the *Bristol Flora*, p. 470). My Mendip specimens agree remarkably well with Sole's beautiful plate.

Polygonum nodosum Poir. (*P. maculatum* Trimen and Dyer). Along a rhine on Nailsea Moor, S., *C.* and *N. Sandwith*. Many further localities may be expected for this species.

Rumex maritimus L. Sparingly on the bank of a rhine on the Kenn side of Nailsea Moor, S., *C.* and *N. Sandwith*. *R. palustris*, which has long been known from this stretch of moor, was growing near by.

Daphne Mezereum L. Still on Churchill Batch, S., last March.

Quercus Cerris L. A single small tree among native bushes on the edge of the cliffs near the base of Cheddar Gorge, S., *Dr. J. N. Mills* and *J. P. M. Brenan*.

Alisma lanceolatum With. Dried-up pond on Inglestone Common, G., *C.* and *N. Sandwith*.

Carex laevigata Sm. Discovered in small quantity in one spot in marshy woodland in the Stoke Lane Valley near Nettlebridge, S., *C.* and *N. Sandwith*. It was growing with *C. sylvatica*, *C. pallescens* and *C. remota*. This is the first certain record for the district of a species whose presence within our limits on Old Red Sandstone or the Coal Measures had for long been suspected (see also *Fl. Bristol*, pp. 36, 638). I have been unable to accept, without further evidence, the record from "Axbridge" which was published in *Rep. Bot. Sect. Som. Arch. Nat. Hist. Soc.*, 1935, p. 4. The dry oak-ash-hazel woods of the slopes of Mendip near Axbridge are not likely to produce *C. laevigata*, and I cannot help thinking that the record is due to error or confusion of some kind.

Glyceria declinata Bréb. New to the district. On the dry mud of ponds in two spots on Inglestone Common near Wickwar, G., *C.* and *N. Sandwith*; and in boggy ground on Mendip, by the stream below Tynning's Farm, on the way down to Shipham Bottom, S., *Dr. J. N. Mills* and *J. P. M. Brenan*. Specimens from both localities have been confirmed by Mr. C. E. Hubbard,

of the Kew Herbarium. This species may have been overlooked in the past, but no local material was found in Mr. White's herbarium at Bristol University, and at the moment I find it difficult to believe that it will prove to be nearly so frequent with us as *G. plicata* and *G. fluitans*. *G. declinata* is less conspicuous than these species, and should be easily recognized by the dense, low-growing habit; the relatively short and broad, intensely glaucous leaves; the short, simple, often curved inflorescence; the short, three-toothed, usually purple-tinted lower pales; and the very short anthers. It has maintained its characters when grown side by side with its ally, *G. plicata*, in water in the Aquatic Garden at Kew.

Ophioglossum vulgatum L. Marshy field at Tickenham, S., Miss M. Bowen.

ALIENS. The following are new to the adventive flora of Bristol: *Medicago minima* (L.) Desr. var. *pulchella* (Lowe) Lowe, a variety with the spines on the fruit reduced to tubercles, new also to Britain, on a tip on the Somerset side of the city; *Crepis setosa* Hall. fil., a single fine plant found by Mr. Ivor Evans under a wall near one of the bridges at Cumberland Basin, G.; and *Calystegia sylvestris* (Willd.) R. et S., a cultivated plant like *C. sepium* but with large flowers and large overlapping inflated bracteoles, on a rubbish tip by Muller Road, Ashley Hill, G. *Chelidonium laciniatum* Mill. occurred at Grove Road, Redland, G. (Ivor Evans); *Portulaca oleracea* L., *Amaranthus vulgarissimus* Speg. and *Axyris amarantoides* L. at Ashley Hill, G.; while *Rapistrum rugosum* (L.) All. has been reported from waste ground at Weston-super-Mare, S., on the strength of a specimen identified at Bristol University.

The British phanerogamic herbarium of the late W. B. Waterfall, who lived in Bristol for many years until his death in 1915 and contributed numerous records to Mr. White's *Flora*, narrowly escaped destruction when the school which possessed it was evacuated from the city. Fortunately, it fell into the hands of Miss M. Bowen who has since presented it to the Kew Herbarium. It contains many specimens from the Plymouth and Bristol districts, as well as duplicates from some of the leading botanists of the owner's day.

At the Annual Exhibition Meeting of the Bristol Naturalists' Society on November 1, exhibits shown by the Botanical Section were ex-

ceptionally good. Mrs. Bell's 'Medicinal Plants' was especially suited to present day conditions, and Mr. Ivor Evans showed specimens of plants new to the district, together with some rarities and peculiarities of growth which were interesting and instructive. Mr. F. W. Evens has recently been studying the structure of seeds and again showed a fine selection. Without the microscope it is impossible to realize the beauty of such minute seeds as those of *Orobanche*, Orchids and other species, beautifully and intricately sculptured, some with delicate lace-like wings. Mr. Rowley's *Cacti* were enlightening to those who did not know how much could be done with the production of these curious plants. The Ecological exhibit staged by Mrs. Boley and Mr. Rowley, representing a lane near Dundry, was a fine example of constructive work. A hundred or more species had been noted and 50 per cent. were shown, the effect of soil conditions and of light or shade on the growth of various plants being carefully demonstrated. These workers defied defeat.

Ornithological Notes, Bristol District, 1941

By H. H. DAVIS, M.B.O.U.

(Received Jan. 17, 1942. Read in title, March 26, 1942)

BIRD-WATCHING activities in 1941 have, of necessity, been much restricted. In spite of this, and a general absence of any such extreme weather as might cause an influx of exceptional visitors, a number of interesting occurrences have been reported. Of these, particular mention may be made of Wood-Larks at Severn Beach in November, a Willow-Tit at Stoke Gifford in February, the visit in January of a small herd of Bewick's Swans to Blagdon and an Arctic Skua at Littleton-on-Severn in June. A Black Redstart made a short stay at Long Ashton in March, the same species being seen at Cheddar and Severn Beach in November, while Hobbies at Blagdon for the fourth successive summer suggests the almost certain breeding of a pair in that area.

Noteworthy visitors on spring migration include Pied Flycatchers in four localities, Grasshopper-Warblers at Dyrham, a Ring-Ouzel at Little Stoke, Bar-tailed Godwits on the Severn mud-flats, and Black Terns at Blagdon. The return passage was surprisingly dull, and at the North Somerset reservoirs the only record of special interest is that of a Sandwich Tern at Cheddar late in September. No autumn observations were possible at Barrow Gurney, but several visits were made to Blagdon and Cheddar, and at both reservoirs waders of any kind were noticeably absent. Along the Severn, however, a small party of Ruffs was seen in August, and a Curlew-Sandpiper* and Bar-tailed Godwits in September.

The following curious varieties were met with near Stoke Gifford during the year—four, of a family party of six, Carrion-Crows with dusky-white patches in both wings, an immature Starling with tail and rump pure white, a female Bullfinch with forehead and crown partially white and, lastly, a light greyish-brown immature Robin, which when seen later as an adult was still retaining the pale greyish upper parts but had assumed a correspondingly pale orange breast. These odd looking specimens were all noted within a distance of little

more than half a mile. Of the Carrion-Crows it may be added that when at rest the birds presented a normal appearance, but when in flight the white wing markings were at once conspicuous. Crows with similar wing patches have been seen in this same locality on several occasions in recent years.

The more important observations by various members of the B.N.S. Ornithological Section are as follows :—

RAVEN (*Corvus c. corax*). No young were reared in the Avon Gorge. The eyrie (on the Somerset side) was seen to be in use toward the end of February but shortly afterwards one of the pair disappeared and the site was deserted. Two were present in the Gorge on December 16, and it is therefore to be hoped that the eyrie will be re-occupied in the forthcoming year. A Raven was heard at Dolebury Warren, on the Mendips, on September 17.

STARLING (*Sturnus v. vulgaris*). In July it became apparent that a roost was forming at High Wood, immediately adjoining the new Filton by-pass. From a small start numbers increased rapidly, and the immense in-coming flocks provided a spectacle of much interest to pedestrians and motorists. By December the total had reached enormous proportions—possibly 150,000 birds, and these were quite evidently being drawn from a wide area covering both sides of the City. The formation and rapid growth of this roost may well have been due to a merging of the Failand and Chipping Sodbury roosts, both of which were found to be out of use early in November.

HAWFINCH (*Coccothraustes c. coccothraustes*). Unusually plentiful in the Leigh Woods area in May and June when not less than twenty pairs were reported to be nesting. One was seen on May 18 in the grounds at Tortworth Court where, with an abundance of suitable nesting sites, the bird is possibly a regular breeder. Recorded in the past as being common at Tortworth (cf. Witchell and Strugnell, *The Fauna and Flora of Gloucestershire*, 1892, p. 65).

SISKIN (*Carduelis spinus*). A party of twelve, or more, was frequenting alders along the River Chew at Publow on November 29.

LESSER REDPOLL (*Carduelis f. cabaret*). Reported as being plentiful in the Leigh Woods area from January until well into May.

CIRL BUNTING (*Emberiza c. cirrus*). Again met with at Severn Beach—five being watched among the hutments on December 7, while two were found near the same spot on the 25th.

TREE-SPARROW (*Passer m. montanus*). Up to twenty or thirty noted at Dyrham on various dates in November and December. Appears scarce here and not known to breed, but probably an overlooked winter visitor.

WOOD-LARK (*Lullula a. arborea*). The unmistakable call was heard at Severn Beach on November 9 and a party of six was viewed at close quarters on fallow ground adjoining Sea-Wall Farm. Apparently scarce on the Gloucestershire side of the City, and not known as a breeding bird. Perhaps occurs more frequently in winter than is generally supposed.

ROCK-PIPIT (*Anthus s. petrosus*). One, either of this or the Scandinavian race (*A. s. littoralis*), was feeding along the water's edge at Cheddar reservoir, on September 21. This is the only recorded instance of the Rock-Pipit at the North Somerset reservoirs.

WHITE WAGTAIL (*Motacilla a. alba*). One was identified beyond doubt at Cheddar reservoir on August 31. Close telescopic views were obtained and the bird was still in almost full breeding plumage.

WILLOW-TIT (*Parus a. kleinschmidti*). A bird clearly identified at Sherborne's Brake, Stoke Gifford, on February 15 may have been the one seen near the same spot toward the end of the previous year. The writer's attention was first drawn to the characteristic nasal call-note, and the bird was later viewed at close quarters (cf. also *Proc., B.N.S.*, 1940, p. 96).

SPOTTED FLYCATCHER (*Muscicapa s. striata*). The following details are the result of observations at Little Stoke, and serve to illustrate a marked devotion to family cares on the part of one of a nesting pair. After an unsuccessful breeding attempt in June, the birds were again building in the first few days of July, and by the 9th or 10th incubation had undoubtedly started. From then onwards the off-duty bird could always be found on some favourite perch near by. On the 20th, however, it was missing, and from that date no more than one bird was at any time present. Meanwhile, incubation continued, and an examination of the nest on the 23rd showed that the young (four in number) were just hatched, either on that or the previous day. Subsequently the remaining bird—most probably the female—was frequently watched taking food to the nest, and this feeding was carried on with untiring effort until the young were finally reared. They (three of the original four) left the nest on the morning of August 6. While it cannot be definitely proved, it may be fairly safe to assume that the remaining

bird was, in fact, the female. It is certainly a matter of doubt as to whether the male alone would have continued with incubation, and have reared the young to so successful a conclusion. As a further point of interest it may be added that butterflies—meadow browns and an occasional tortoiseshell—were frequently taken to the nest by this hard-worked flycatcher. Although opportunities were plentiful, no attempt was made to capture light-coloured species such as whites and brimstones.

PIED FLYCATCHER (*Muscicapa h. hypoleuca*). Noted on spring migration as follows—two males, Kingsweston Down on April 28; a female, Dyrham Rectory on May 3 and 4; a male, Tickenham on April 26 and May 3; and a male, Leigh Woods in May.

GRASSHOPPER-WARBLER (*Locustella n. naevia*). Twice met with at Dyrham on spring passage—one on April 22 and another on May 4.

REED-WARBLER (*Acrocephalus s. scirpaceus*). Found nesting in usual numbers at Littleton-on-Severn. May also breed regularly at Oldbury-on-Severn, where several pairs were located in a large reed bed on June 29.

RING-OUZEL (*Turdus t. torquatus*). A female was seen in a hedgerow at Little Stoke Farm, Stoke Gifford, on May 6.

REDSTART (*Phænicurus ph. phænicurus*). Evidently nests fairly commonly in pollard willows in the Thornbury area, where, between Morton and Rockhampton, four or five males were heard in song on May 3 and adults were seen feeding fledged young on several subsequent dates. A male in an orchard at Oldbury-on-Severn on June 29 was probably one of a nesting pair. This is the only breeding information within recent years for the Gloucestershire side of the district.

BLACK REDSTART (*Phænicurus o. gibraltariensis*). Met with on three occasions—one about the laboratory buildings at the Long Ashton Research Station from March 21 to 26, one in the pleasure grounds at Severn Beach on November 9 and one at Cheddar reservoir on the 16th. All were either female or immature.

DIPPER (*Cinclus c. gularis*). Still occurs along the River Frome at Stapleton where one was watched near the old Colston School baths on October 21. Breeding here has been strongly suspected on one occasion within recent years, while further up-stream, at Hambrook, nesting has once been reported. (For previous remarks on the Dipper in this area cf. *Proc., B.N.S.*, 1934, p. 570 and 1935, p. 125.)

SAND-MARTIN (*Riparia r. riparia*). Drain-pipe breeding again noted in a railway cutting at Bedminster, and in a roadside wall at Stapleton.

SWIFT (*Apus a. apus*). A very large passage movement was evidently in progress at Blagdon on May 25 when the number was estimated at not less than two thousand birds. Many were seen high overhead while others were literally swarming over the whole reservoir.

PEREGRINE FALCON (*Falco p. peregrinus*). A single bird was observed at Aust Cliff on September 9 and again on the 15th. One, a tiercel, was seen in the Avon Gorge on October 15.

HOBBY (*Falco s. subbuteo*). Three were watched circling over Blagdon reservoir on August 31—one of which was viewed at fairly close quarters and appeared to be a young bird.

MERLIN (*Falco c. aesalon*). Good views were obtained of one along the coastline near Clevedon on October 25.

COMMON HERON (*Ardea c. cinerea*). A census of breeding pairs at the Brockley Combe and Banwell Heronries was again undertaken. Twenty-four occupied nests were counted at Brockley on June 8, while of forty-one nests at Banwell on May 11 thirty-nine were found to be in use.

BEWICK'S SWAN (*Cygnus b. bewickii*). Four (two adults and two immatures) were watched at the Ubley end of Blagdon reservoir on January 12. This is only the second record for the North Somerset reservoirs and the first for Blagdon.

WHITE-FRONTED GOOSE (*Anser a. albifrons*). Thirteen were feeding along the river bank below Severn Beach on December 25. Twenty geese flying in a N.W. direction over Henleaze on December 19, and twelve going S.E. over Dyrham on the 29th were, in both cases, probably this species.

SHELD-DUCK (*Tadorna tadorna*). One was present at Blagdon on March 30 and two on April 13.

GOLDENEYE (*Bucephala c. clangula*). Up to fourteen or more were seen at Blagdon reservoir on various dates from early March to mid-April. Two were still present on May 10.

COMMON SCOTER (*Melanitta n. nigra*). An adult male was found dead at Blagdon on April 8.

SMEW (*Mergus albellus*). Twice seen at Blagdon—two on January 12 and three on March 9. Two were noted on No. 1 reservoir, Barrow Gurney, on November 30. All were "redheads."

BLACK-NECKED GREBE (*Podiceps n. nigricollis*). Observed at each of the main North Somerset reservoirs—one at Blagdon on March 9 and 30, and again on May 4; two at Cheddar on September 28 and one at Barrow Gurney on November 30.

BAR-TAILED GODWIT (*Limosa l. lapponica*). Four (including two in red plumage) were seen on the Avonmouth-Severn Beach mud-flats on May 10, and five were frequenting the same place on September 9.

WOODCOCK (*Scolopax rusticola*). One was flushed in Leigh Woods on various occasions early in the year. It remained until the beginning of May but was not seen afterwards.

JACK SNIBE (*Lymnocryptes minimus*). A bird was shot from marshy ground adjoining Dyrham Wood on December 23.

TURNSTONE (*Arenaria i. interpres*). Seen in the usual numbers off Severn Beach early in the year and again on various dates from August to December. Also once met with at New Passage—a party of twelve on November 23. Two were seen further up the river at Oldbury on September 7.

KNOT (*Calidris c. canutus*). The only records are of one on the Avonmouth-Severn Beach mud-flats on August 24 and one in the same place on September 7.

CURLEW-SANDPIPER (*Calidris testacea*). A single bird, among Dunlin, below Severn Beach on September 7 is the only record for the year.

PURPLE SANDPIPER (*Calidris m. maritima*). Noted at Severn Beach—four on February 16, and at New Passage—two on November 23.

SANDERLING (*Crocethia alba*). Only one record—that of a single bird (in full summer plumage) off Severn Beach on May 10.

RUFF (*Philomachus pugnax*). On August 24 good telescopic views were obtained of a party of five, apparently immature birds, along the Avonmouth-Severn Beach mud-flats. Only once previously recorded for this stretch of the river.

COMMON SANDPIPER (*Actitis hypoleucos*). A single bird was observed at Cheddar reservoir as late as November 16.

RINGED PLOVER (*Charadrius h. hiaticula*). Three were seen at Chew Magna reservoir on May 10. A fairly frequent visitor in small numbers to the larger reservoirs but scarce elsewhere inland.

GREY PLOVER (*Squatarola squatarola*). Seen on the mud-flats between Avonmouth and Severn Beach as follows—three on September 14, and single birds on October 12 and December 7.

BLACK TERN (*Chlidonias n. niger*). Three were hawking over Blagdon reservoir on May 4.

SANDWICH TERN (*Sterna s. sandvicensis*). One, resting on a wire hawser, at Cheddar reservoir on September 28 was clearly identified by its large size (as compared with Common Tern) and by its correspondingly large black bill and its black legs. Records for the district are few and the bird appears to be no more than a very occasional visitor.

GREAT BLACK-BACKED GULL (*Larus marinus*). Apparently becoming increasingly common along the Avon in winter. No less than eight were counted between Sea Mills and the Suspension Bridge on October 18, while three were feeding at a drain as far up as Ashton Swing Bridge on December 15.

ARCTIC SKUA (*Stercorarius parasiticus*). A close view was obtained of one in flight at Littleton-on-Severn on June 1. The bird was in the dark plumage phase and was probably on passage to its northerly breeding ground. This is the only authentic record for the Gloucestershire side of the district.

CORN-CRAKE (*Crex crex*). A bird sent to the Bristol Museum was shot from a root-field near Whitechurch on September 2.

COOT (*Fulica a. atra*). Two in the floating harbour on February 15 were swimming within sight of St. Augustine's Parade. Extremely numerous, perhaps approaching the one thousand mark, at Blagdon on March 9, and equally plentiful at Cheddar reservoir on November 16. A pair with young was seen in a disused clay-pit at Littleton-on-Severn on June 1. Breeding here has not previously been recorded.

Hudd's and Thompson's Notes on "Melville Island Flowers"

By NICHOLAS POLUNIN, M.S., M.A., D.Phil.

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IN 1872 (*Proc. B.N.S.*, VII, pp. 43-45) A. E. Hudd gave an account, entitled "Notes on some Melville Island Flowers," of a small but historically interesting collection of arctic dicotyledonous plants which are now in the B.N.S. Library, whence I recently received them on loan through the courtesy of the Hon. Librarian. Hudd's account was, on the whole, a tolerably careful one for those days, though his "nearly sixty species" of flowering plants then 'known' from Melville Island was already too low an estimate and has of course been further added to since. Of Hudd's list (*l.c.*, p. 44) of 43 plants, about half are given names which, according to our present way of thinking, are either wrong or incomplete. This is due in some instances to mis-identification, in others to changes in nomenclature, and in yet others to the fact that the plants belong to separate varieties or *formae* within the species mentioned. Furthermore, in two instances Hudd was able to give only the generic name, and in three others queried his own identifications, while, perhaps most important of all, he omitted to mention several of the most significant plants contained in the collection.

The late H. S. Thompson, A.L.S., recognised that there were errors in Hudd's list. He sent a number of the sheets to Kew for identification and published several emendations (in "Notes on Melville Island Flowers," *Proc. B.N.S.* 4 ser., VIII, pp. 365-6, 1938). With most of these I am unable to agree, while some constitute definite steps backwards. It therefore seems desirable to offer the following completely revised list. In it the new determinations are my own, based on many years' study of arctic plants both in the field and in numerous herbaria, but all have been most kindly checked through and approved by Mr. A. J. Wilmott, F.L.S., Deputy Keeper of Botany in the British Museum. The species in general follow the sequence

adopted by Hudd. The letters H. and T. refer to Hudd (*l.c.*) and Thompson (*l.c.*), respectively :—

Ranunculus nivalis L. (It would appear from his MS. notes and his mention (*l.c.*, p. 44) of “forty-three species” that H. meant to report only one *Ranunculus* although his printed list suggests both *R. nivalis* and “var sulphureus, Soland”. This latter is nowadays usually maintained as a distinct species). Of the six axes stuck on the sheet originally labelled “*Ranunculus Sulphureus*,” five are indeed referable to that species but one clearly belongs to *R. nivalis*.

R. sulphureus Solander apud Phipps (see above).

Papaver radicum Rottb. (H. “*Papaver nudicaule*”—synonym *pro parte*).

Draba alpina L. [approaching var. *nana* Hook., emend. Fernald]. (Only part of the sheet labelled “*Draba Alpina*” is referable to this, the rest belonging instead to the next species).

D. fladnizensis Wulfen, *s.l.* (Missed by H. and T.—see above).

**D. glabella* Pursh (H. “*Draba androsacea*”; including scraps of *Lesquerella arctica* (*q.v.*) and of the next *Draba*).

D. cinerea Adams (Missed by H. and T.—see above).

Cochlearia officinalis L. var. *groenlandica* (L.) Gelert apud Andersson & Hesselman (H. “*Cochlearia fenestrata*”). There is another scrap of this on the sheet of *Loiseleuria procumbens* (*q.v.*).

Parrya arctica R. Br. (Note correct spelling).

**Cardamine pratensis* L. var. *angustifolia* Hook. (Cf. T.; H. “*Cardamine*, sp. ?”).

Lesquerella arctica (Wormskj.) S. Wats. (Cf. T. except as regards the author of the specific name; originally labelled “*Senecio*,” and wisely omitted by H.). There is another scrap of this on the sheet of *Draba glabella*—see above.

Lychnis apetala L.

Silene acaulis (L.) L. var. *exscapa* (All.) DC. (H. “*Silene acaulis*”).

Cerastium alpinum L., *s.l.* [approaching var. *lanatum* (Lam.) Hegetschw.].

Stellaria longipes Goldie (H. “*Stellaria Edwardsii*”).

Arenaria rubella (Wahlenb.) Sm. (Cf. H., but by T. wrongly given as “= *A. verna* L.”).

A. Rossii R. Br. apud Richardson *var. *Daethiana* Polunin (H. "Arenaria . . . Rossii").

Saxifraga oppositifolia L.

S. Hirculus L. var. *propinqua* (R. Br.) Simmons (H. "Saxifraga Hirculus . . . ?").

S. flagellaris Willd. ex Sternb.

S. tricuspidata Rottb.

S. rivularis L.

S. caespitosa L. f. *uniflora* (R. Br.) Engler & Irmscher (H. "Saxifraga caespitosa").

S. nivalis L.

**S. aizoides* L. (H. "Saxifraga Sp. ?").

S. cernua L.

Chrysosplenium alternifolium L. var. *tetrandrum* Lund (H. "Chrysosplenium alternifolium").

Dryas integrifolia M. Vahl (p. p. *maj.*) and *f. *intermedia* (Nathorst) Polunin (p. p. *min.*). (Cf. H. but contrast T.).

Potentilla pulchella R. Br.

Potentilla: apparently various hybrids (H. "Potentilla nivea").

Astragalus alpinus L.

**Oxytropis Maydelliana* Trautv. (H. "Oxytropis arctica," T. "a duplicate sheet" of the next).

Oxytropis coronaminis Fernald (T. "Oxytropis arctica"; by H. apparently considered the same as the last sheet).

**Epilobium latifolium* L.

Senecio palustris (L.) Hook. var. *congestus* (R. Br.) Hook. (H. "Cineraria congesta" (synonym); by T. wrongly given as "= *C. palustris*"). Upper part of the specimen only; the lower part belongs to the next genus.

Petasites sp. (Lower part of the last specimen, missed by H. and T.).

Antennaria labradorica Nutt. (H. "Antennaria alpina").

**Erigeron eriocephalum* J. Vahl (H. "Erigeron uniflorum," T. "*E. uniflora*" (sic)).

**Matricaria inodora* L. var. *nana* (Hook.) Torrey & Gray, emend. Polunin (H. "Pyrethrum alpinum," T. "*Matricaria Hookeri*").

Campanula uniflora L. (H. " *Campanula uniflora* . . . ? ").

Cassiope tetragona (L.) D. Don (H. " *Andromeda tetragona* " (synonym)).

**Ledum palustre* L. var. *decumbens* Ait. (H. " *Ledum palustre* ").

**Loiseleuria procumbens* (L.) Desv. This sheet includes also a scrap of *Cochlearia officinalis* var. *groenlandica* (see above).

Pedicularis Langsdorffii Fisch. ex Stev. var. *arctica* (R. Br.) Polunin (H. " *Pedicularis arctica* " (synonym)).

**Armeria maritima* (Miller) Willd., s.l.

Polygonum viviparum L.

Oxyria digyna (L.) Hill.

Salix arctica Pall., s.l.

**Mertensia maritima* (L.) S. F. Gray var. *tenella* Fries (H. " *Onosma micrantha* (?)," T. " *Trientalis arctica* Fisch.").

Thus on the 45 sheets composing the collection there are represented 49 different species of flowering plants, not 43 as reported by Hudd.

It may be noted that so far I have refrained from commenting on the source of origin of the plants. Both Hudd (*l.c.*, p. 43) and Thompson (*l.c.*, p. 365) give this as Melville Island, but, after careful consideration from many aspects, I have come to consider this as by no means certain in all cases though it may well be true in some. The chief difficulty is that with one exception the sheets are unlocalized with anything approaching an (apparently) contemporary label. The exception is the sheet of *Saxifraga Hirculus* var. *propinqua*, and this would appear to have been selected to exemplify the whole collection on account of being the most attractive 'flower' of all. It bears the inscription "Specimens of Botany from Melville Island, North Georgia; collected in Augst. and Septr. 1820, 1822, and 1823 by Lieutt. Bushnan R.N." A further difficulty, which was presumably recognized and ignored as a probable error by Hudd but not by Thompson (*l.c.*), is that, whereas Bushnan was indeed with Parry in the Arctic in all of the three years mentioned on the label, it was only in the collecting season of the first of these years that they visited Melville Island. Either the date or the place is wrong, and unfortunately it has proved impossible to determine which. It is true that the geographical distributions of some species most pertinent in this connection suggest Melville Island as their probable place of origin,

but the majority of specimens might at least as well have come from Melville *Peninsula*, which lies far to the south-east and was the chief centre of activity of the next Parry expedition in 1822 and 1823. In these circumstances of grave doubt, the only reasonable course will be to refrain from including any of these 'records' in detailed phytogeographical citations. On the other hand, if we were to assume that the present collection did indeed come from Melville Island, we would have to add to the normally accepted (but itself not always certainly known) 'flora' of that very considerable land-mass the 11 species and 2 further intraspecific entities starred in the above list; most of these indeed seem likely to occur on Melville Island but all still require confirmation. I purposely say "normally accepted" because Hudd's and Thompson's papers have been almost entirely overlooked or ignored by phytogeographers; and I say "itself not always certainly known" because, on reading Parry's "Journal" of his 'first' voyage, one cannot help doubting the validity of the general assumption that all the plants described by Robert Brown in his famous "*Chloris Melvilliana*" necessarily came from Melville Island. Finally, it seems clear that the present collection was not among those considered by Brown when drawing up his "List of Plants collected . . . by the Officers of the Voyage."

Studies on the Biology of the Bristol Channel

VIII*

AN ACCOUNT OF COLLECTING STATIONS, AND CORRECTIONS TO THE FAUNA LIST

By R. BASSINDALE, M.Sc.

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1. INTRODUCTION

IN continuing studies on the biology of the Bristol Channel attention has been directed recently to the invertebrate fauna of the southern shores. The main results of a survey have been published in the form of a fauna list (Bassindale, 1941). A general account is in preparation, and a more detailed contribution on the amphipods of the estuary has been published,* but an account of the collecting stations has not been included in any of these papers and will be given here. Since its publication certain errors have been noted in the fauna list and these will be corrected.

Acknowledgments of assistance received during the survey were made in the fauna list and the expenses of publication of the present paper have been borne by the Leverhulme Trustees.

2. A DESCRIPTION OF THE COLLECTING STATIONS WITH NOTES ON THEIR FLORA AND FAUNA

(i) General.

The collecting stations visited stretch from Haw Bridge to Porlock Weir, a distance of 97 miles. Their positions, and their distances from King Road (Avonmouth), are shown in the accompanying map (Fig. 2). Distances have been measured by opisometer along the winding, low-water channel from Haw Bridge to Blue Anchor Bay and thence due west. A more detailed chart of the area will be presented elsewhere, and Admiralty Charts of the river up to Sharpness are also available. Geographical and geological data have been obtained

* Part VII of this series, "The Distribution of Amphipods in the Severn Estuary and Bristol Channel," by R. Bassindale, is published in the *Journal of Animal Ecology*, Vol. XI, pp. 131-144.

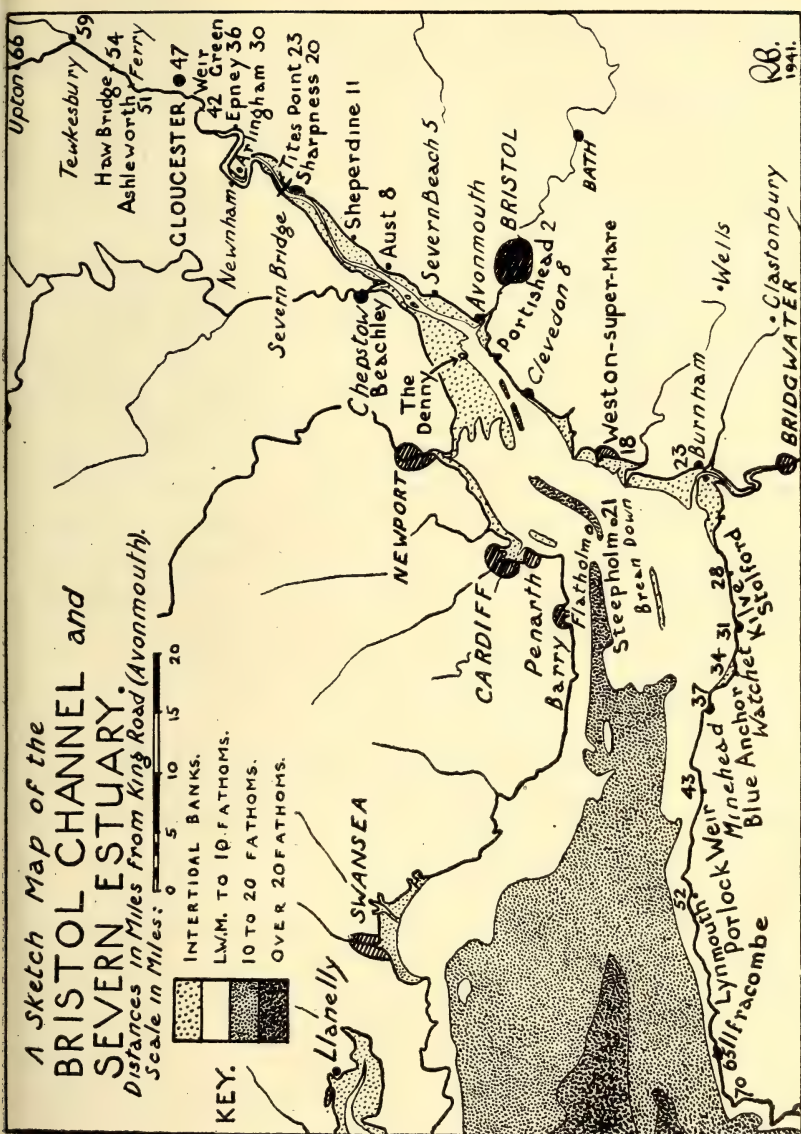


FIG. 2.

from the *Severn Barrage Reports* (1933) and from Professor W. F. Whittard, to whom my thanks are due.

General divisions of the estuary may be made as follows :—

(a) At Haw Bridge and Ashleworth Ferry the river is navigable and occasionally tidal. The water is probably always fresh.

(b) From Gloucester West to Epney, including Weir Green and Elmore Back, the river is tidal except during neaps, and is saline at Epney and may be so up to Gloucester West during good spring tides. This is the zone affected by the bore.

(c) From Arlingham downwards the river is tidal even during neaps and the estuary widens noticeably from about this point.. The reaches down to Aust or Portishead (Arlingham, Purton, Sharpness, Sheperdine, Aust, Portishead) represent a zone of very arduous salinity conditions, into which marine animals penetrate to a varying extent. It is also a zone where much silt is washed about by the rapid currents.

(d) From Portishead seawards (Portishead, Weston, Kilve, Blue Anchor), there is a zone of increasingly favourable marine conditions with less and less silt in suspension and less and less salinity variation. Marine animals listed number 75 species at Blue Anchor and they die out less rapidly between Blue Anchor and Portishead than between Portishead and Sharpness.

(ii) The collecting stations.

Haw Bridge.

The river at Haw Bridge is navigable and has steep earth banks covered by reeds or tufts of grass. Collecting is difficult and the fauna poor. The only species found were chironomid larvae and males of a new species of *Corophium*.

Ashleworth Ferry.

The river is navigable and has steep, reed-covered banks. On the right bank at the Ferry (a row-boat passenger ferry), the river is shoal close inshore, and has numerous stones suitable for sheltering the *Limnea*, *Theodoxus*, *Gammarus* and leeches found there. In addition, young mullet were recorded once and a "salinity" of 0.7 g.p.l. may have indicated the presence of saline waters from the Droitwich Spa region.

Gloucester West.

This station and the two named above are tidal but are only affected on the highest spring tides. The water is probably never affected by salt water except from Droitwich Spa.

The river divides above Gloucester, and both branches, which re-unite at Lower Parting below Gloucester, can be reached from the Gloucester to Ross main road. The western branch is not canalised and is similar in nature to the Haw Bridge station. The eastern branch is protected from all except extreme spring tides by Lanthony Weir just above Lower Parting.

Weir Green and Elmore Back.

Elmore Back was sampled on the first visit because the Weir Green by-road was overlooked. The latter is more accessible but both stations have the steep earth banks with reeds which are found at Gloucester West and Haw Bridge, and, in common with those stations, have a poor fresh-water fauna together with a brackish-water species of *Gammarus* (*G. zaddachi* Form C). The tidal nature of the river is more marked than at the other stations but only spring tides affect this region and the water may be slightly affected by salt water on the highest springs.

Epney.

The river begins to widen at Epney and a sand bank is visible on the right bank. On the left bank the steep earth banks may have a small area of muddy foreshore exposed at low tide or when the river is low. In common with the other stations above this point (except Ashleworth Ferry), there is a poor fresh-water fauna with *G. zaddachi* Form C. In all cases, except the Ferry, the type of habitat is not very suitable for the development of a large *Gammarus* population, and, despite the interesting nature of the species in this zone, only few specimens could be obtained.

Two species of the green sea-weed, *Enteromorpha*, occur here, and the Anchor Inn is the site of an elver station worked for the export of living elvers to Germany. Elvers are much fished in this region (Lloyd, 1941).

Neap tides do not reach Epney, but on springs, which flow for about an hour, it is a good place at which to see the Severn bore. This feature of the river probably explains the paucity of the fauna, in specimens if not in species. Salt water penetrates to Epney on spring tides (on the authority of Mr. Rogers of the Anchor Inn).

Arlingham Passage.

The row-boat ferry from Arlingham to Newnham is situated in the middle of a very wide loop where the river, now nearly 500 yards across, is wider than at Epney. A sand bank, exposed at low water,

is continuous with the steep earth and mud slope which marks the shore line on the Arlingham side of the river. The tides appear to make the bank unstable and render it unsuitable for animal life. On one occasion more than 6 inches of sand had been deposited on one part of the bank. Mysids and the isopod, *Eurydice pulchra*, have been obtained some time after high water in summer. The physical conditions are well defined by the samples recorded elsewhere. The station is little affected by neap tides but very much by spring tides, when turbidity and salinity are high.

Tites Point, Purton.

The river is very wide, and extensive sand banks occur. The shore consists of a flat of salt-marsh grassland with pools, and a more or less steeply sloping mud bank, inhabited by the polychaete worm, *Nereis diversicolor*, leading to the low-level sand bank. A deep pool separates the sand and mud just at Tites Point, and a breakwater of large stones provides a holdfast for the highest recorded plants of the bladderwrack, *Fucus vesiculosus*. *Enteromorpha* occurs, but it is also recorded from Epney. The salt-marsh pools had an abundant fauna of unusually smooth-backed *Sphaeroma rugicauda*. Seaward of Tites Point the rocks exposed are of Upper Silurian sandstone and shale, but upstream of the breakwater there is an interesting exposure, through the mud bank, of Lias shales and limestones with ammonites embedded.

Sharpness.

The part of the shore examined lies between the new and the old canal entrance locks. At H.W.M. there is an area of salt-marsh grassland, and, sloping gently down from this, a mud bank inhabited by *Nereis diversicolor*. Towards L.W.M. the mud gives way to level sand which extends well out into the estuary. Between L.W.M. and M.T.L. are exposures of rock and shingle where *Gammarus* occurs. Further upstream reefs of friable red marl and cornstone (the Down-tonian beds of Upper Silurian age) jut out from a low cliff and extend down to low water. These silt-covered rocks provide a holdfast for *Fucus vesiculosus* and two species of *Enteromorpha* (*E. intestinalis* and another), but the conditions are very muddy. Sand of a loose shifting type occurs near the old (disused) canal entrance, and on the vertical wall forming the estuary bank just here are good growths of *Pelvetia canaliculata*, *Fucus spiralis*, *Enteromorpha* and *Ascophyllum nodosum*.

Several marine species are recorded from this station and the most notable is *Balanus improvisus*. Isolated specimens were present on the wall of the tidal basin, and they were much larger than the specimens living lower down the estuary. Salt water penetrates to Sharpness on all tides, and the current is strong and turbulent. In winter, at low tide, the water may often be fresh, but in summer it is usually more or less saline.

Sheperdine.

The estuary at Sheperdine is over two miles wide and the low-water channel is separated from the left bank by a mud flat 500 yards wide. From this point the channel swings across the estuary, to lie close to the right bank, leaving a two-mile-wide bank on the left shore. At the upper end of this bank there is much rock exposed (red Triassic marl), and the part examined by walking out to the channel, some 1,200 yards offshore near the navigation lights, consisted of varying patches of rock, pebbles, gravel, sand and mud. The retaining bank, which borders the estuary in this region, is faced with stone and extends down to about Ordnance Datum level. From here a mud and rock slope sinks to about nine feet below O.D. and thence rises by terraces to a maximum height at about O.D. level on High Heron Rocks. From this level there is a rapid fall across muddy shingle to a subsidiary channel which makes the Narlwood Rocks normally inaccessible. The terracing is produced by the presence of thin sandstone layers in the marl. A little upstream, at the Ledges, the edge of the tidal bank is of rock and comprises a vertical cliff, of varying height, which falls directly into the channel at 10 or 15 feet below O.D. with no shingle intervening.

There is much weed present at this station. On the stone facing of the embankment, *Pelvetia canaliculata*, *Fucus spiralis* and *Enteromorpha* are common, while *Fucus vesiculosus* and *Ascophyllum nodosum* occur less commonly low down on the wall or on boulders lying on the mud. Once across the muddy, inshore depression and on to the mixed area of rock, pebbles and mud, *Fucus vesiculosus*, *F. serratus* and *Chondrus crispus* are common. *F. serratus* is more common offshore than inshore, and *Ulva lactuca* (?) also occurs. *Ascophyllum nodosum* reappears on the highest part of High Heron Rocks, and plants up to eight feet long were seen on the Ledges.

Apart from the abundance of *Gammarus* species, there are two main features of interest at this station. Firstly, there occurs commonly in one small area an abundance of a very dark variety of the nemertine

Lineus gesserensis, and, secondly, the distribution of sea-weeds is, in two places, clearly shown to be dependent on the nature of the rock. On the embankment the stones are of two types—faced and unfaced. These occur in zones, and the weeds, *Pelvetia canaliculata* and *Fucus spiralis*, are similarly zoned and only colonise the unfaced, much pitted stones. At the highest point on the High Heron Rocks there is a layer of a yellowish sandstone overlying the red friable rock which constitutes the main mass. On this yellowish rock *Ascophyllum* grows well. Wherever the rock is broken away and the level is thereby changed a few inches at most, *Fucus serratus* occurs but *Ascophyllum* is absent. Similarly, *Ascophyllum* occurs only on the stratum of yellow rock on the Ledges.

Aust.

At Aust the estuary narrows down to a width of about one mile; and most of this is covered at low water so that inter-tidal banks are relatively small. On the left bank there is a high cliff whose base near H.W.M. is of red Triassic marl. From this cliff the shore falls, over sand and boulders at high water neaps, across a mud bank inhabited by *Nereis diversicolor* and the bivalve, *Macoma balthica*, to an extensive rock flat at L.W.M. which is 400 yards from the cliff. Upstream of this there is a high reef of the red marl covered by sea-weeds. The depressed centre of the reef is drained, on the ebb tide, by a gully which runs from inshore of the reef, round the downstream side and so on into the channel. Several rocky islands near the reef are attainable at low water of spring tides from the rock platform at L.W.M., and, like the main reef, their sides rise vertically from the platform. The marl gives way at L.W.M. to a dolomitic Carboniferous limestone and it is of this rock that the islands are made. The bottom of the channel is believed to be of limestone (*Severn Barrage Committee Report*, 1933).

The main weeds on the reef are *Ascophyllum nodosum* and *Fucus serratus*. Other species—*Fucus vesiculosus*, *Chondrus crispus*, *Cladophora rupestris*, *Ulva lactuca* and *Ceramium rubrum* have also been found on the reef, while *Enteromorpha* occurs in a fresh-water drip on the cliff face.

Gammarus zaddachi is abundant near L.W.M., and other interesting members of the fauna—which is becoming gradually more extensive as we approach the sea—are the hydroids, *Tubularia indivisa* and *Sertularia cupressina*, which occur in extreme abundance on the reef at L.W.S.T., and the anemone *Tealia felina*, of which species two

specimens were seen on several occasions under a stone in the gully. The polychaete worm, *Amphitrite johnstoni*, occurs rarely at L.W.M. of ordinary tides but regularly at L.W. of extreme spring tides.

The water is always saline except rarely at low water in winter, and has always a high silt content. The daily salinity range is small except during neap tides in winter.

Portishead.

The beach at Portishead has been investigated by Purchon (1937), and his paper may be consulted for details of this collecting station. Royal Beach alone has been visited for the purposes of the present survey, and areas of both rock and mud, with some sand and shingle at H.W.M., have been examined. The rock is Pennant sandstone, and further west a dolomitic Triassic conglomerate shelves down to the water line. The rocks are weed-covered, and the general appearance of the shore is muddy. The fauna is larger than at Aust but there is nothing that deserves special comment except the presence of small reefs composed of tubes of the polychaete worm *Sabellaria alveolata*. The reefs were recorded by Matthews in 1923, Purchon found them uninhabited in 1936, and they were absent in 1939, 1940 and 1941. Reefs also occur at Clevedon, and living worms were seen in the summer, 1941.

The water is turbid and the tidal current strong. The range of salinity is probably less than at Aust.

Weston-super-Mare.

At Weston, a rocky headland of Carboniferous Limestone juts out towards an island of the same rock. This is Birnbeck Island and is connected to the mainland by the Old Pier. It is surrounded by a foreshore of naked rock, or of boulders and shingle, which gives way north and south to the mud and sand of two wide bays. The island can be approached over the rocky foreshore at low tide and by the pier at any time. The collections made during this survey were from the inshore (east) and north sides of the island and from the sand and mud near the New Pier in Weston Bay to the south. All the algae reported from the up-river stations are present, with the red weeds, *Porphyra*, *Polysiphonia* and *Corallina* in addition.

The fauna is typically marine, and notable features are the following. *Sabellaria alveolata* occurs on the bare rock at L.W.S.T. on Birnbeck Island, and somewhat below L.W. neaps on the shingle bed inshore and north of the island. Each colony on the shingle consists of a small group of 10 to 20 specimens on a single large pebble. The hydroid,

Laomedia gelatinosa, is also abundant on the shingle bed. *Tubularia indivisa* grows to a large size, and a numerous colony of *Tealia felina* occurs just where rock gives way to mud at L.W.S.T. and many of the specimens are buried to disc level in soft slurry. The amphipods, *Gammarellus homari* and *Calliopius crenulatus*, and the isopod, *Eurydice pulchra*, are more common here than elsewhere, and F. J. Ebling has recorded the tubicolous polychaete worm, *Platynereis dumerili*, on *Corallina*.

The water is turbid and the tidal currents are strong. The daily range of salinity is not more than 1 g.p.l. and the seasonal range about 7 g.p.l.

Kilve.

The shore at Kilve is approached by a stream valley, and the stream flows on to the shore over and through a shingle rampart. East and west of this position the shingle gives way to cliffs which increase to a considerable height. They are composed of alternating layers of hard limestone and friable shale (Liassic) and on the shore these strata present a series of slabs and gullies. The gullies run along the shore and the shore falls gradually in a series of steps, each step representing a limestone bed over a layer of shale. By means of these gullies the fresh water of the stream is distributed over a wide area of the shore. Immediately opposite the stream-valley the limestone beds are high and stretch out seawards. East of this an area of flat rock and boulders, called here *the reef*, also juts out. In between, a shallow, V-shaped gully penetrates the shore; near L.W.M. it is paved with rock over-laid by about 12 inches of soft mud, and higher up, as the gully narrows, the mud eventually gives way to dirty sand which joins the shingle lining the foot of the cliff.

Sea-weeds are common on the reef and the same species are present as at Weston. Outstanding features of the fauna are the abundance of the characteristic flatworm, *Procerodes ulvae*, in the stream near H.W.M., the presence of *Gammarus stoerensis* in this same area, and the presence of the cumacean, *Diastylis rathkei*, in the mud and water of the gully. Areas of shale low on the shore are riddled by boring molluscs, and at L.W.M. on the reef numerous specimens of the sub-littoral starfish, *Solaster papposus*, have been seen.

The physical conditions are probably similar to those at Weston. Parts of the shore are, however, clean and not muddy. Tidal currents are almost certainly diminishing in speed and the turbidity of the water may be less.

Blue Anchor Bay.

The road, built on a sea-wall, forms part of the high water mark of this extensive bay. At the east end the road turns inland where a cliff rises to form the high water limit of the shore. This cliff is of the same nature as that at Aust (friable, red, Triassic marl, with veins of alabaster). The foreshore itself is, however, composed of limestone and shale as at Kilve, although the rocks are actually Rhætic shales not Liassic. Where the road borders the shore, and to the west where sand dunes take the place of the road at H.W.M., the extensive foreshore is of sand which gives way to mud near L.W.M. Further west, shingle appears and a very extensive bed of shingle, which stretches away to Minehead, forms the western end of Blue Anchor Bay.

At the east end of the bay the appearance of the shore and the fauna and flora are strikingly similar to those at Kilve. At the west end, on the shingle, the collecting was unexpectedly poor.

The main features of the fauna were its increasing variety (75 species were recorded in three days' collecting), more particularly the increase in the number of polychaetes, and also the presence of many dogwhelks, *Nucella lapillus*, where no food animals could be found.

The physical conditions at the east end of the bay are fairly similar to those at Kilve and Weston. The channel lies close to the shore and its turbid waters and mud deposits make the shore very muddy. The shingle at the west end is clean.

Porlock Weir.

Collections have been made on this rock and shingle beach and, although not yet worked out, it is known that the fauna represents an increase on the numbers at Blue Anchor. Some notable additions are species of echinoderms, sponges, nudibranchs and one ascidian, all of which occurred in abundance. The cliffs are of Devonian grits and shales.

Other collecting stations.

Further collecting stations are tentatively placed at Lynmouth and Ilfracombe, and additions to the fauna are still to be expected because the snail, *Littorina neritoides*, a red, encrusting sponge, and a compound ascidian, none of which were present at Porlock Weir, have been seen at Lynmouth.

3. CORRECTIONS TO THE FAUNA LIST

Occasional collections continue to be made along the shores of the estuary so that new information is continually being recorded. It will eventually be necessary to prepare a supplement to the fauna list (Bassindale, 1941), but for the present, attention may be directed to the following points.

The data in a paper by C. B. Rees on the mud fauna near Cardiff (Rees, 1940) were not included, but of the many species recorded, most are known to occur in this part of the estuary. The additional species identified by Rees are the anemone, *Diadume luciae* (Verrill); the polychaete, *Nereis succinea* (Leuckart); the oligochaete, *Clitellio arenarius* O. F. Müller; the copepods, *Stenhelia palustris* (Brady), *Nannopus palustris* Brady and *Platychelipus littoralis* Brady; and the ostracod, *Leptocythere castanea* (G.O. Sars).

The main error in the fauna list was to describe the three types of *Gammarus zaddachi* as "varieties" and to attribute them to G. M. Spooner: two of these forms had already been discriminated in the original description of the species (Sexton, 1912) and only the third was separated (provisionally) by Mr. Spooner. It has been decided, in discussion with Mrs. Sexton, to refer to the three types as Forms A, B and C, and the following corrections should be made on pp. 170 to 172 under the general heading of *Gammarus zaddachi*:—

For 'Saline Variety A Spooner (*in lit.*)' read 'Form A Sexton.'

„ 'Saline Variety B Spooner (*in lit.*)' read 'Form B Spooner (*in lit.*).'

„ 'Typical variety Spooner (*in lit.*)' read 'Form C Sexton.'

The use of the term 'form' in place of 'variety' is an indication that the status of these 'forms' is not known and, indeed, individuals intermediate between Forms A and B, as well as between A and C, are common. It is hoped to throw light on the nature of the variations by means of experiments now proceeding.

In the fish fauna list (Lloyd, 1941), there is also an omission. Add the following entry on p. 211 above 'Salmonidae':—

STERNOPTYCHIDAE

Maurolicus muelleri (Gmelin)

This small deep-sea fish has luminous organs, and Higgins (1861) took seven specimens at Weston-super-Mare. These specimens are recorded as '*M. pennanti* . . . three specimens in July' by Day, 1880, and as *M. borealis* in Matthews (1933). One was taken in the nets at Stolford on 20.5.39 and named by J. R. Norman of the British Museum.

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Studies on the Biology of the Bristol Channel

IX

A SURVEY OF THE FISHING INDUSTRY AT WESTON-SUPER-MARE DURING THE WINTER OF 1940-41

By A. J. LLOYD, PH.D.

(Received, Feb. 26, 1942. Read in title, March 26, 1942)

INTRODUCTION

DURING the winter of 1940-41 a survey of the fishing industry at Weston-super-Mare was carried out with special reference to the sprat fishery. The occurrence of the sprat in this region of the Bristol Channel during the winter months has long been the cause of an important fishery. On the 30th of November, 1491, over one hundred horseloads of "sprat barons," four hundred young cod, three hundred haddocks and two hundred whittings were taken in the fishery at Anchor Head. During the 17th Century the Lord of the Manor used to grant leases of his tenements for the lives of two, three or four people and to give as appurtenant to the holding, the right to occupy and fish two or three fishing stalls in his private fishery on the foreshore of Weston Bay, chiefly at Birnbeck. Baker (1851) records that "as much as a ton of sprats was known to have been retailed in Taunton market in one day and from information collected with great care I learn that the sprat fishery from the west end of the Gore Sand in Bridgwater Bay to Weston-super-Mare will produce in a good season more than £10,000 at the retail prices."

In 1887 vast quantities of sprats were present in the Channel. One fisherman sent away ten wagon loads in one week and was in debt for the carriage. A smoke shed was erected immediately after this but there has never been a sufficient quantity to warrant its use.

Formerly more than 300 stow nets were fished under Brean Down in addition to those around Birnbeck. The nets of the former fishery were removed finally about 1901. At least 50 swing nets were in use in the Bay; at the present time there are only fifteen.

The stow nets are fixed in the "stalls," which consist of strong poles 18 ft. in length. The nets are about 48 ft. in circumference at

the mouth and of a conical shape. These nets only fish the ebb tide. In design and manufacture they are essentially similar to the swing nets.

The swing nets have been in use at Weston for less than 100 years. These are anchored and buoyed with a barrel in the tide-way so that both the ebb and flow are fished. A disc-shaped mass of concrete forms the anchor, into which is embedded a length of 1 inch chain; attached to this is a further length of $\frac{1}{2}$ -inch chain and 4-inch warp. From this warp four 2-inch rope spans pass to the four corners of the nets. The net is lashed to two 17-foot beams, the upper of wood and the lower of heavy iron tubing. It is hauled by the tripping rope which passes through two fair leads at the centre of either beam and thence to the barrel float.

Smaller swing nets, with a mouth circumference of 64 ft. and a depth of 33 ft., are used during the spring tides. The neap tide nets have a mouth circumference of 84 ft. and are 41 ft. deep. The greater part of the net is of $1\frac{1}{2}$ -inch mesh decreasing to $\frac{1}{2}$ -inch mesh at the cod-end.

A minimum of four nets for each set of gear is necessary to ensure replacement when damage occurs. The nets are changed every week, and after drying are "barked" with cutch and oak bark. They are visited only at slack water; the beams are drawn up at the bow of the boat by means of the tripping rope. The meshed sprats are shaken out and the cod-end is brought inboard and the fish placed in baskets.

SURVEY OF FISHINGS

The 20 stalls in use at Birnbeck Island are owned by three fishermen; every available net was in operation in 1940-41 during the run of fish. The nets were in many cases unsound and did not stand up to the gales experienced at this time. Each fisherman retails his own catch and there is very little wastage.

The stow net fishery at Middle Hope Cove is rented from Deerhurst Priory by Mr. Thomas of Sand Bay. He could fish more than 30 nets but only used 6 during this season. It is a difficult fishery to work owing to its situation; there is no adjacent roadway, and during the greatest influx of fish he possessed no means of transport. Arrangements were finally made to utilize the waste fish for pig swill. Mr. Thomas was hampered both by lack of capital and of labour and by his geographical position.

The swing net fishery at Weston is worked by three families, Messrs. Tancock, Messrs. Webb and Messrs. Watts. Greater quantities of fish were landed during 1940-41 than at any time during the previous

25 years. The commercial fish were disposed of through the usual channels. The small sprats and whiting were also utilized, the greater part at a canning factory at Yeovil. Local farmers also used it for pig swill during week-ends when the factory was unable to take it. An estimated total of 300 cwt. of waste fish which would have normally been thrown away was used for human food. Full records of the catches made by Messrs. Webb were obtained (Graph I, Fig. 3). A basket of fish holds about 84 lbs. Robertson (1938) states with justification that "a market for canned sprats exists, the sources of an increased supply of raw material lie close at hand, and the prospects of the further development of this industry depend largely on its ability to adapt itself to the particular circumstances of the sprat fishery in this country. If it were successful in these efforts it would render great service to itself, to the public and to the inshore fisherman." Needless to state, in the present emergency these prophetic words cannot be over emphasized.

SPRATS.

A daily sample of the sprats was measured throughout the season. The length in millimetres was measured from the tip of the snout to the end of the longest caudal fin rays. The tail fin was not spread out in its normal swimming position. A total of over 12,000 sprats were dealt with during the fishing season 1940-1941.

The sprats taken at the beginning of November possessed large fat reserves which gradually disappeared during the winter. They are not considered by the fishermen to be "in condition" unless they will fry in their own fat. The gonads were very small in both male and female fish but showed a gradual increase in size towards the end of the season. No stomach contents were found in any of the sprats examined.

It was found, in practice, that more white bait (i.e. small fish) were obtained by the larger nets used on the neap tides. The increase in size of the belly of the net may extend the fishing area of the smaller mesh tail part; moreover, the tide flow, being less, probably does not force the small sprats through the meshes. During the strong spring tides the size of the net is further lessened by hitching the sides of the mouth and so preventing the risk of damage. Much chafing of the fish occurs at these times, especially if the cod end is only half full, and the caudal fin rays are frequently much damaged. Ford (1933) observes that during the summer the white bait sprats in the mouths

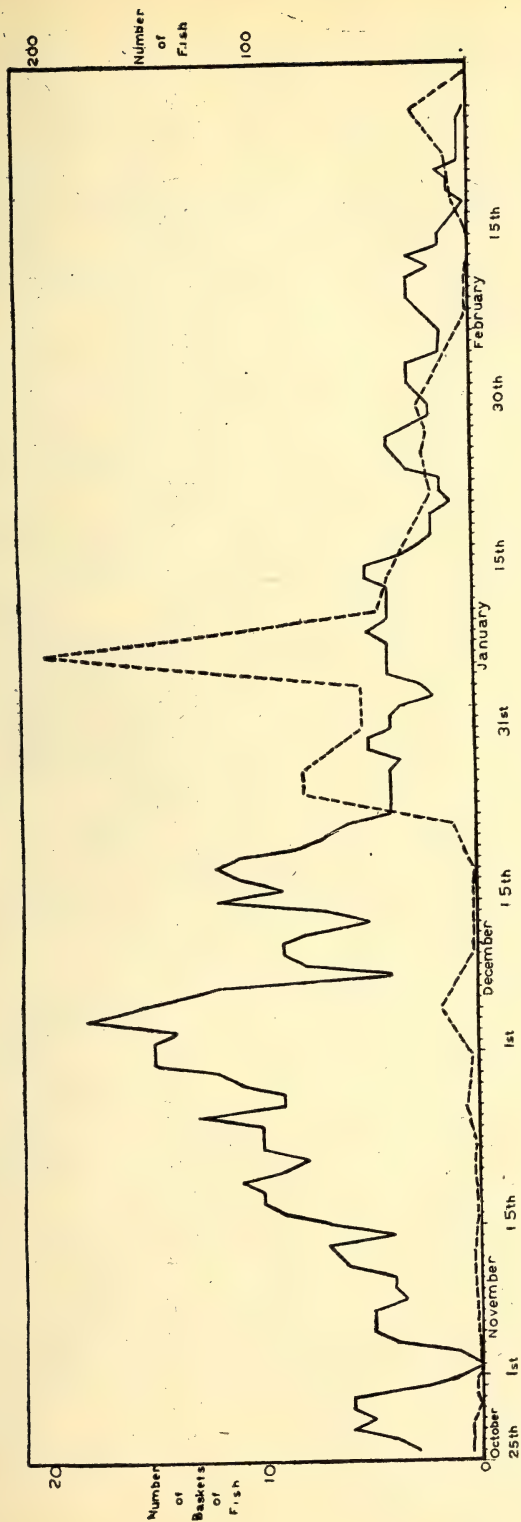


FIG. 3

GRAPH I. The continuous line represents the total number of baskets of fish landed at Weston during the winter 1940-41; the discontinuous line represents the number of sprats landed at Oldbury during the winter 1937-38.

of the rivers near Plymouth lose a part of the caudal fin rays, and he connects this with the estuarine habitat.

The sprats which have spent some time in the estuary acquire a bluish tint whereas a fresh shoal has a green appearance (greenbacks).

A few white bait sprats are present in the estuary throughout the year. These do not appear to increase in size and probably move out to the adult shoals when they reach a certain size. There were no small herrings in the white bait samples.

The results of periodic measurements are incorporated in Graph II, Fig. 4. The total number of sprats measured is shown in each case. At the beginning of the season the length variation was from 70-120 mm. The youngest and oldest sprats did not appear until the beginning of November. During the second week of November a greater number appeared with lengths of 115 to 130 mm. In the third week white bait sprats of lengths 40-60 mm. made their appearance. Robertson (1938) considers that the white bait sprats, unlike the adults, shoal according to size and this is borne out by the graph. The presence of large numbers of sprats about 80 mm. in length was observed throughout the season. Robertson found similar sized fish only in his samples from Brightlingsea, near the Thames, where stow nets are in use. This type of gear closely resembles the Weston swing net and does not operate selectively. These fish were probably spawned early during the preceding spring or may have been favourably affected by the feeding conditions on the nursery ground. He states that the white bait samples of 50 mm. size are about 6 months old. At an age of 18 months the sprat measures some 115 mm., and spawning occurs soon after. According to the *Plymouth Marine Fauna* (1931) the spawning period there extends from mid-February to mid-July. Heidrich (1923) states that each sprat spawns eight or nine batches of eggs over a period of 4 to $4\frac{1}{2}$ months. After maturity is reached the growth rate is slowed down so that lengths of 125, 130 and 133 mm. are obtained at the end of $2\frac{1}{2}$, $3\frac{1}{2}$, and $4\frac{1}{2}$ years respectively. Thus the sprats exceeding 110 mm. in length, which are of commercial value, are over 18 months old.

Graph I shows the daily fluctuation in the quantity of fish landed at Weston. The largest landings of sprats were made in the first week of December, 1940. It is not possible to estimate the proportions of large and small sprats owing to the fact that numbers of small whiting were included in the factory material. The sprats taken at Oldbury during the winter 1937-38 are also shown in Graph I. The largest

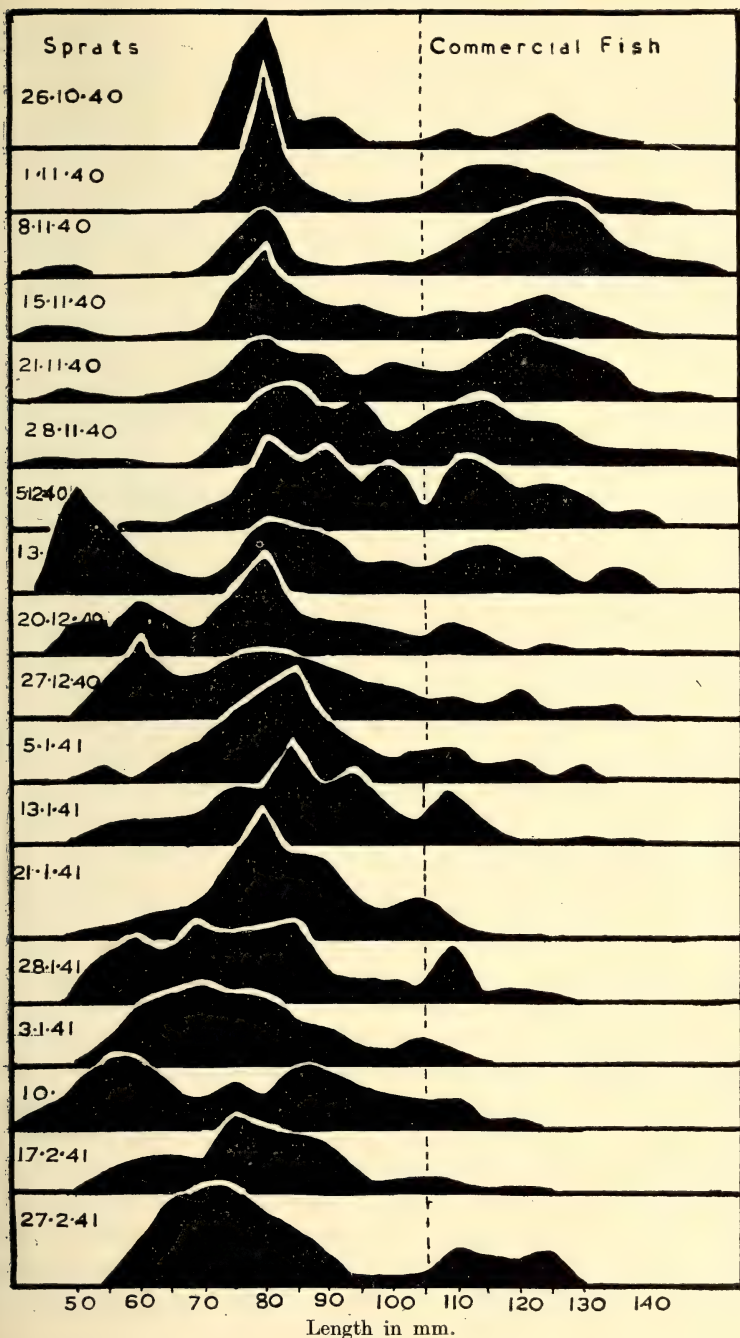


FIG. 4

GRAPH II. The variations in length of sprats during the season 1940-41.

numbers occurred during the latter part of December and early January. Until recently the sprat migrations into the Severn had appreciably fallen off.

The fact that different shoals of fish are caught at different times and the incidence of large numbers of the older classes during November and the beginning of December and their subsequent disappearance are shown clearly in Graph II. There is a relatively steady abundance of fish around the 80 mm. mode, comprising fish about one year old, throughout the season.

The white bait samples consist of fish from 6 months to 1 year old, in the size groups 50-80 mm., which appear in large numbers during the latter part of January and throughout February. The six months' duration of the spawning season obviously precludes the possibility of placing each fish in certain age groups, and unfortunately the scales are all lost by friction in the nets, as the fish are rarely meshed, so that scale reading is impossible.

Large numbers of sprats parasitized by members of the copepod genus *Lernæenicus* were collected. These parasites when found attached to the eyes are called by the fishermen "tears in the eyes." *Lernæenicus sprattæ* (Sowerby) is found attached to the eye, and *L. encrasicola* (Turton) to the back of the fish close to the dorsal fin. Frequently two parasites attach themselves to the same fish. Daily samples of sprats, together with all parasitized fish, were preserved in formalin for future research.

HERRINGS

At certain times large numbers of herrings were taken in the sprat shoals. During the sorting of the catch, all herrings were removed and measured. The first fish were taken in December, the greater proportion being approximately the same size as the commercial sprats. According to Hodgson (1925) these would be fish of the second year class of 130-150 mm. in length. A few of the first year class of 80 mm. length appeared in January and February. Mature fish of the fourth year class, 230 mm. in length, were present in small numbers in November and December. There was little variation in size of the main second year class throughout the season. No herrings were present in the white bait samples so that it is probable that the herrings do not migrate into the Severn until the second year. This appearance of herrings in the Severn is quite abnormal. No herrings were present during the winters 1939-40 and 1941-42.

WHITING

These fish were present in varying quantities throughout the winter. The catch of large whiting over 180 mm. in length composed from one-third to one-half of the daily catches shown in Graph I. Samples were measured at regular intervals, in all over 4,000 fish, and the results obtained are shown in Graph III, Fig. 5. The majority of fish were of commercial size, from 180 to 230 mm. long, during the major part of the season. The main size groups, shown at 200, 210 and 220 mm., were remarkably constant throughout the season (Graph III). According to Cunningham (1896) these would belong to the second year class whilst the smaller fish of 100-140 mm. length taken during January and February were members of the first year class. Very large numbers of small whiting, about 80 mm. in length, were taken throughout the estuary during the summer but the majority of these young fish move off into deeper waters with the lowering of the water temperature. A few larger fish of older year classes were present during November and December but absent later. The stomach contents showed small sprats, shrimps, mysids, prawns, *Idotea*, etc. The bulk of the catch was transported to various wholesale markets and local shops.

A high proportion of the fish were parasitized by *Lernæa branchialis* and consequently in poor condition. A collection of these fish was also made for future research.

CODLING

Large numbers of codling, ranging in size from 30 to 50 cm. in length, were present in the estuary from the third week in December. Long lines were fished at various situations in Weston Bay by all the swing net fishermen. The lines consist of light rope with snoods at intervals of 6 feet; about 100 hooks are fished on each line. Medium sized sprats, about 110-120 mm. in length, are the best bait; if a larger size is used the fish often takes half of the bait without the hook. At the beginning of February, lines were placed in the main channel some miles from the shore, and greater quantities were taken. One or two adult specimens were taken in poor condition, one female being full of roe. The estuary was populated by very large numbers of small cod of the first year class during 1939. The stomach contents included sprats, crustacea including swimming crabs, and lug worms.

FLOUNDERS

These consisted of small, immature fish feeding on shrimps, small

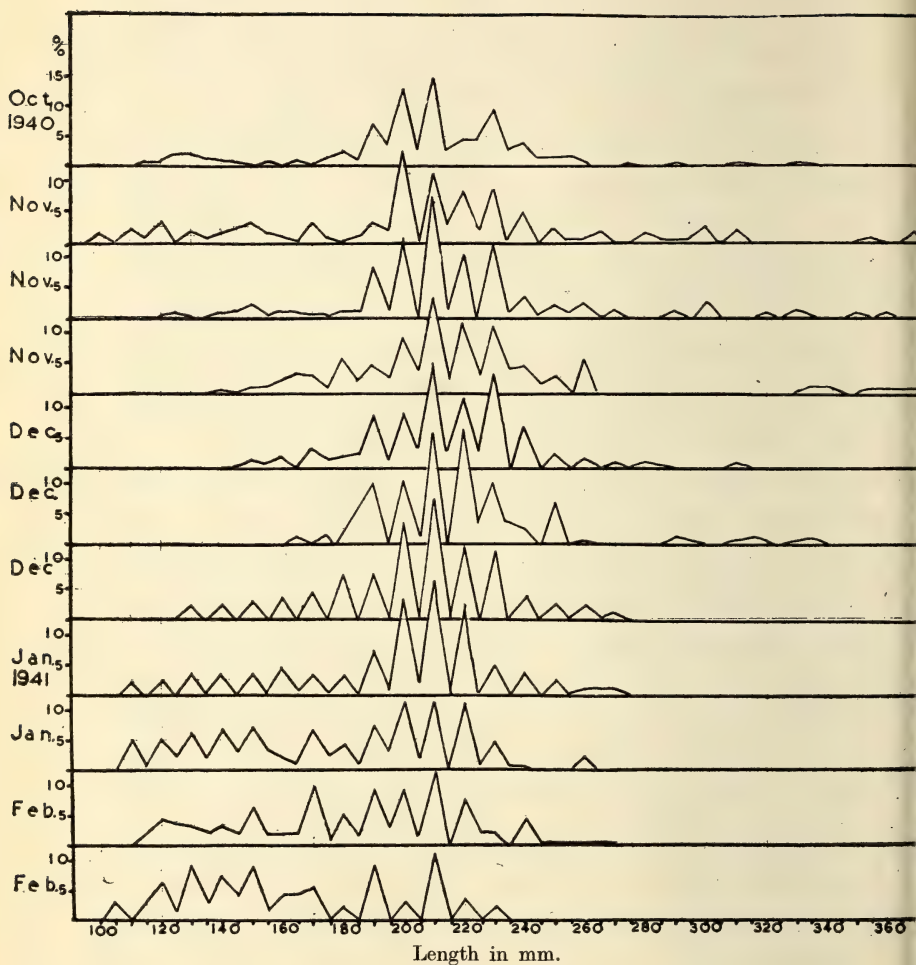


FIG. 5

GRAPH III. The variations in length of whiting during the season 1940-41.

Data collected on all possible days and grouped into three series for November and December and into two series for January and February.

molluscs and worms. The majority ranged in length from 80 to 160 mm. The smallest of these consisted of second year fish spawned in April but the ages of the larger fish cannot be directly related to size. Only the largest specimens, over 14 cm. in length, were marketable.

PLAICE

The majority of these were large and in good condition. A few small, immature fish of 110 mm. length were taken but the mature fish showed ripening gonads. These fish, over 220 mm. long, were probably considerably over three years old, Hickling (1937) recording growth increments of 30-50 mm. annually for fish up to 80 mm. in length. During the season 1941-42 some exceptionally large specimens weighing over 6 lbs. were taken.

SOLES

Large numbers of small fish were taken in the estuary during the summer of 1939. A few of these remained over the winter as the 70-90 mm. group. No fish of edible size was caught. The food consisted of small molluscs and worms.

DABS

These constituted the commonest type of flatfish but few were of marketable size.

In addition to the above flatfish, a few specimens of the lemon sole (*Pleuronectes microcephalus*) and the brill were taken.

Conger eels of various sizes were occasionally taken throughout the season. Their food consisted largely of small fish.

RAYS AND DOGFISH

A few adult thornback rays were taken on the long lines during November but then disappeared until the end of February when they reappeared in full-roed condition. This absence was unprecedented. The November fish were poorly nourished, with small gonads. The measurement across the disc ranged from 45 to 55 cm. and there were about equal numbers of the two sexes. They were feeding on sprats and herrings with occasional swimming crabs. Large numbers of small specimens were taken in the swing nets during November and December but subsequently disappeared. Stevens (1931, 1932) found that the thornback was the commonest ray in the commercial landings at Plymouth.

Occasional specimens of both *Scyllium canicula* and *Acanthias vulgaris*, ranging in size from 55 to 73 cm. in length, were taken during

October and November. There were equal numbers of both sexes and the gonads were ripening.

GENERAL COLLECTION

With the co-operation of the fishermen, collections of all non-commercial fishes were made. A six-foot sturgeon weighing over 100 lbs. was taken on a sprat-baited hook on Jan. 10, 1941. This is the first specimen to be taken for many years. Other rare visitors included:—*Callionymus lyra* (8.11.40, 1 specimen); *Capros aper* (8.11.40, 1 spec.); *Clupea finta* (15.1.41, 1 spec.); *Lota vulgaris* (7.1.41, 1 spec.); *Merluccius merluccius* (24.11.40, 3 specs.); *Raja batis* (5.1.41, 1 spec.); *Raniceps raninus* (9.11.40, 1 spec.); *Scomber scombrus* (9.12.40, 1 spec.). This is the fourth specimen of the burbot (*Lota vulgaris*) taken in the Channel or Severn Estuary in the past five years (Lloyd, 1938).

The common shrimp, *Crangon vulgaris*, was present in numbers throughout the season. Shrimps usually leave the upper reaches of the Channel during winter but owing to the mildness of the season no such offshore migration took place. Very large numbers of the prawn, *Leander squilla*, were present until the middle of December, after which they disappeared. Occasional specimens of the glass shrimp, *Pasiphae sivado*, were also taken, some carrying eggs.

Note on the Fishery of 1941-42

Occasional visits were made to Weston during the winter of 1941-42, and the general course of the fishery followed. Sprats did not begin to appear until the beginning of December, and landings were not so great as in the preceding year when conditions were certainly exceptionally good. However, large quantities of sprats were marketed, the relative proportions of white bait to large sprats being similar to those of the previous season. Owing to the unprecedented scarcity of fish, larger quantities of the white bait were sold in local shops. The whiting were mainly of large size, exceeding 200 mm. in length, but smaller fish were also sold. The canning industry took all unmarketable fish. There was a keen demand for rays and dogfish. The sprat fishery ceased about mid-February with the disappearance of the fish. Herrings were absent and there were fewer specimens of non-commercial fishes generally. No rare specimens of note were taken.

Acknowledgments

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Studies on the Biology of the Bristol Channel

X

THE CATCHES OF A SOMERSET FISH WEIR

By L. HARRISON MATTHEWS, M.A., Sc.D.

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ON any part of the coast where there is sufficient range of tide, the ancient method of catching fish by means of fixed engines can be practised. The simplest form of fixed engine is the fish weir, which is essentially a V-shaped fence with the apex pointing seawards, within which fish are trapped and left stranded when the tide ebbs. The development of such a contrivance by primitive people who had found fish trapped in pools left by the tide can easily be imagined, and fish weirs in one form or another are found all over the world. The great range of tide in the Bristol Channel makes its coasts very suitable for this method of fishing, and in former times it was much practised.

Fish weirs, locally known as "hangs," were in extensive use until the close of the last century, since when they have fallen into decay and are now extinct. They were constructed by driving stout poles at intervals into the mud of the shore, and filling the spaces between posts with withies lashed vertically to horizontal ropes. The walls thus formed were inclined towards each other, and the angle where they met was known as the "bitts." It was at this point that the trapped fish were concentrated.

When these old-fashioned hangs were falling into disuse a few new ones were constructed by hanging nets on stakes set in the mud on a similar plan; but these more frail structures were easily damaged by rough weather, and were never extensively used. Of quite recent years a few hangs have been made using wire netting fastened to stakes, and one of them forms the subject of the present notes.

Towards the end of 1935 two wire netting hangs were erected on the shore between Brean Down and Burnham-on-Sea, one near Berrow and the other near Brean. Some information about the catches made at one of these during a period of sixteen months has been preserved.

It is of particular interest because no exact information about the catches of any of the Bristol Channel inshore fisheries has previously been available.

Each wall of these hangs was about 200 yards long, and the bitts were about 50 yards seaward of the line joining the outer ends of the walls. In plan the hangs were thus in the shape of a shallow V with widespread arms. For its construction each required 600 oak posts eight feet in length, sunk three to four feet into the ground. Four hundred yards of 14-gauge wire netting, 2-inch mesh, four feet high, was lashed to the posts, and two hundred yards, two feet high, was buried in the ground at the base of the posts towards the centre of the V. During two years of fishing, the Brean hang was so badly damaged by storms as to require rebuilding four times. The hangs cost about £100 each to erect in 1935. They were fished at a nominal rent under licence from the owners of the foreshore, the Lords of the Manor at Berrow, and the Board of Trade acting as agents for the Crown at Brean.

The Brean hang was on firm sand, but the Berrow one was on the mud seaward of the sand. At Brean the mud lies less than a foot below the surface. Two feet under the surface there is a layer, two feet thick, of black hard turf which is dry inside. This layer of turf is about four feet below the surface at Berrow. Under the turf in both places lies alluvial clay. When the hangs were in use the tide scoured a channel at the bases of the posts so that a pool was left at low water. The fish were dipped out of these pools with a hand net. The pool at Brean did not become very deep because the ground was fairly hard; but at Berrow the ground was so soft that very soon the pool deepened so that it was impossible to catch the enclosed fish. Lines of footsteps made in the mud by the fishermen were also very soon scoured into channels. The hang at Berrow was abandoned before that at Brean for this reason. Both the Brean and Berrow hangs were arranged to fish, that is to dry out, at about half ebb.

Poachers were especially troublesome at Brean. In the summer there were often as many as a hundred people from the holiday camps nearby trying to steal fish as the tide ebbed; this in spite of the presence of the fishermen warning them off. Even in the middle of the night thieves attempted to loot the hang.

In the first year's fishing the catches were very good, but they fell off very seriously in the autumn of 1936. Consequently a log of daily catches and weather was started in September, 1936, in order to check

results, but it refers to the Brean hang only, the one at Berrow having already become unusable. During the preceding year the catches were said to have been at least three times as great.

The information contained in the daily log is summarised in Table I. Eight sorts of fish were recorded, of which four, whiting, conger, bass and sole, require no special comment. The fish recorded under the heading "dabs" were certainly of several species, and judging from

TABLE I

Date.	Days of fishing.	Days with no catch.	Weight of fish, lbs.	Dabs.	Whiting.	Codling.	Skate.	Conger.	Grey Mullet	Bass.	Sole.
1936.											
Sept.	3	—	37	3	—	—	2	1	—	—	—
Oct.	31	—	491	31	13	8	7	3	—	—	—
Nov.	6	—	123	6	2	8	—	—	—	—	—
Dec.	31	6	150	15	12	6	—	—	—	—	—
1937.											
Jan.	31	12	62 $\frac{1}{2}$	17	9	13	—	—	5	—	—
Feb.	18	1	62 $\frac{3}{4}$	15	8	16	—	—	7	1	—
Mar.	14	—	43 $\frac{1}{4}$	12	3	4	—	—	9	1	—
Apr.	30	—	212 $\frac{1}{4}$	29	2	1	3	—	14	10	—
May	31	—	368 $\frac{3}{4}$	31	1	—	1	2	10	5	1
June	30	—	151 $\frac{1}{2}$	30	—	—	5	1	—	—	4
July	31	—	176 $\frac{1}{2}$	31	—	—	5	1	1	—	2
Aug.	31	—	209 $\frac{1}{4}$	30	—	—	5	2	1	—	2
Sept.	30	—	246	30	1	2	8	6	5	—	1
Oct.	31	12	38 $\frac{3}{4}$	12	5	5	1	—	—	—	—
Nov.	30	18	18 $\frac{1}{2}$	7	5	—	—	—	—	—	—
Dec.	13	24	7 $\frac{1}{4}$	4	3	—	—	—	—	—	—

The numbers in the columns under the names of fish refer to the number of days on which the species were taken: they do not refer to numbers or weights of fish. Storm damage to the hang reduced the number of days fished in Nov., 1936, and Feb.-Mar., 1937.

available information they must have been a mixture of flounders (*Pleuronectes flesus*) and dabs (*P. limanda*) with a lesser number of plaice (*P. platessa*). They formed the greater part of the catch, being present nearly every day on which fish were taken. Large cod (*Gadus morrhua*) were never taken, although they occur plentifully in the Channel: perhaps the hang was too far inshore to trap them. Codling are small cod up to four or five pounds in weight. The fish recorded under the heading "skate" were probably mostly thornbacks (*Raia clavata*), but other species of ray may also have been present. The grey mullet were probably *Mugil chelo*, the thick-lipped grey mullet.

The figures give some information on the variation of the fish population of Bridgwater Bay. Flat fish were nearly always present in quantity, whereas the numbers of the other species show a seasonal fluctuation. Codling and whiting of marketable size occurred in the autumn, winter and spring, and were absent during the summer months. The numbers of skate and conger increased during the summer, and these species were not taken during the winter. This is not due to their absence from the district during that season, for they are taken in some numbers at that time on long-lines laid in deeper water below low-tide line in Weston Bay. It appears, therefore, that they do not come so far inshore over the mudflats during the colder months. Grey mullet appeared in the catches most plentifully in spring, and this was probably due to an inshore migration possibly connected with spawning, which takes place in the summer. The spring appearance of bass is also possibly due to a similar cause.

The quantity of fish taken, as shown by the monthly weights of the catches, varied considerably, but remained at a remunerative level until the autumn of 1937. In the last three months of that year the catches fell away so greatly that the use of the hang was abandoned when it was badly damaged at the end of the year. In the previous winter, catches had been poor: in January, 1937, there were twelve days when no fish were taken, and the total weight for the month was small. However, in the following months the catches improved again, and one wonders whether it would not have been wise to persevere in spite of the poor catches of the autumn of 1937, in the expectation of a similar improvement in 1938. In the last three months of 1937 no fish were caught on fifty-four days out of ninety-two, and the results were so disappointing that the hang was dismantled.

The variations in the quantities of fish taken were closely correlated

with the direction of the wind. A summary of the wind directions and the total catches is shown in Table II. The data up to October, 1937, are shown first, and those for the last three months of the year, when results were very poor, are shown separately: the combined data for the entire period are given finally. Inspection of the tables shows that the largest catches were made when the wind was N, NW or NE, and the smallest when the wind was S, SE or E. When the wind was SW or W the catches were intermediate and not very great.

TABLE II

Wind direction ..	N	NW	W	SW	S	SE	E	NE
Sept. 28, 1936, to Oct. 2, 1937								
Occurrences, days ..	8	21	65	102	103	4	6	10
Total catch, lbs. ..	133 $\frac{3}{4}$	310 $\frac{3}{4}$	536 $\frac{1}{2}$	705 $\frac{1}{2}$	354 $\frac{1}{2}$	9 $\frac{1}{2}$	4 $\frac{1}{2}$	270 $\frac{1}{4}$
Catch, lbs. per day ..	16.75	15.0	8.25	6.9	3.4	2.25	0.75	27.0
Oct. 3, 1937, to Dec. 31, 1937.								
Occurrences, days ..	10	6	20	27	10	3	8	6
Total catch, lbs. ..	5 $\frac{1}{2}$	10 $\frac{1}{2}$	12	10 $\frac{3}{4}$	6 $\frac{1}{2}$	4	1	2 $\frac{3}{4}$
Catch, lbs. per day ..	0.55	1.75	0.6	0.4	0.65	1.3	0.1	0.46
Sept. 28, 1936, to Dec. 31, 1937.								
Occurrences, days ..	18	27	85	129	113	7	14	16
Total catch, lbs. ..	139 $\frac{1}{4}$	321 $\frac{1}{4}$	548 $\frac{1}{2}$	716 $\frac{1}{4}$	361	13 $\frac{1}{2}$	5 $\frac{1}{2}$	273
Catch, lbs. per day ..	7.7	11.9	6.6	5.6	3.2	2.0	0.4	17.0

From the information available it is impossible to find a definite reason for these correlations. At first sight it might be imagined that comparatively calm water gave the conditions for the best catches, because the Brean mudflats are sheltered by Brean Down and the coast of Bridgwater Bay when the wind is N, NW or NE. This is particularly so when the wind is NE, the direction associated with by far the largest catches. But calm water cannot be the required condition, for the waters of the Bay are almost equally sheltered when the wind is E, SE or S, when the worst catches occurred. Fig. 6 shows graphically, first the average number of pounds of fish caught daily when the

wind was in each quarter, and secondly the number of days when the wind lay in each quarter. Inspection of this figure shows a rather disappointing state of things from the fisherman's point of view, for only medium catches were made when the wind was in the prevailing directions, S, SW and W, and the really good catches occurred when the wind came from other and infrequent quarters.

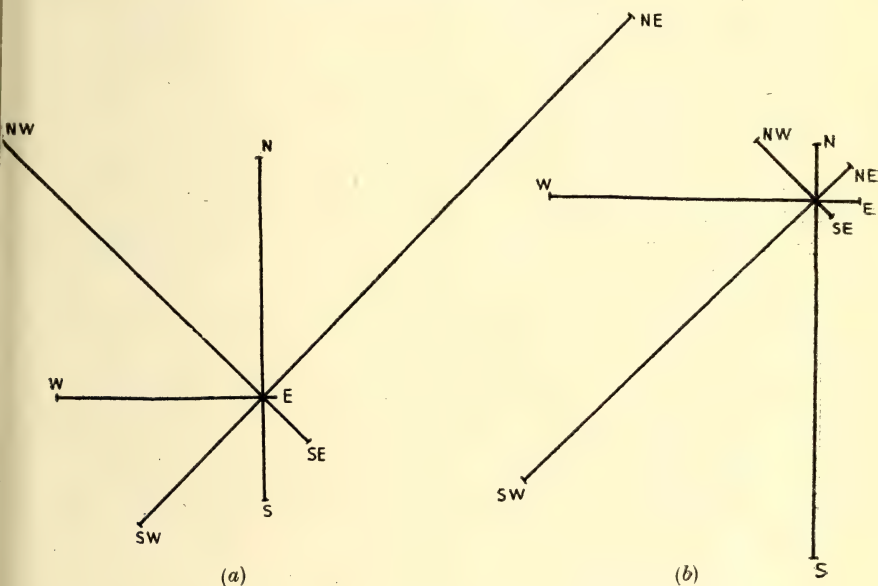


FIG. 6.

Diagrams to show the correlation between the direction of the wind and the quantity of fish taken at the Brean hang, Sept. 28, 1936, to Dec. 21, 1937.

(a) The lengths of the arms are proportional to the total weight of fish taken when the wind was in each quarter. (b) The lengths of the arms are proportional to the number of days when the wind was in each quarter. It is seen that the best catches were made when the wind was in the least frequent quarters.

The total catch was 2,378 pounds, taken during 409 days' fishing, of which 73 had no catch, giving an average catch of 5.84 pounds daily. The wind was N, NW or NE on 15% of the days, during which 31% of the catch was taken; it was S, SE or E on 33% of the days, during which 16% of the catch was made; and SW or W on 52% of the days, during which 54% of the catch was made. It is thus apparent that the few really good days' catches were roughly balanced by the larger number of very poor ones, and that the best and worst together were roughly equal to the intermediate catches made when the wind was in the prevailing quarters.

Some of the older local fishermen say that after a hang has been in use for two or three months it has " caught all the fish off the ground " and must be moved. When this occurs with a twine netting hang the netting can be taken down and put up again on other stakes elsewhere so that full catches continue. But a wire netting hang, once fixed, has to remain, for it is impossible to handle the netting after it has been in use. It is difficult to believe that such mobile creatures as fish can be removed from a given part of the shore by a hang, but the figures given above do certainly indicate that there is a definite reduction in the numbers of fish caught after a hang has been in use for some time.

The writer wishes to express his thanks to Chas. Holt, Esq. and James Vale, Esq. of Burnham-on-Sea for kindly making available the information in the daily log. Acknowledgments are also due to the Leverhulme Trustees for assistance towards the cost of publication of this paper.

A High Viséan Fauna from the vicinity of Yate, Gloucestershire; with special reference to the Corals and to a Goniatite

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CONSIDERING so much has already been written concerning the palæontology of the Bristol district, some explanation is needed for occupying space in these *Proceedings* with an account of a high Viséan fauna from the vicinity of Yate, particularly as the forms recorded are not very many. The reasons are these:—(i) The fossils were collected from calcareous beds intercalated in the arenaceous series which succeed the limestone sequence and are generally mapped as "Millstone Grit." The fauna of this horizon is not well known and any additions to our knowledge of it are useful. (ii) The beds are now mostly under water and are likely to remain permanently so, and therefore the opportunity of collecting material except from the lowest and highest members may not occur again. (iii) The assemblage, although only a small one, includes elements new or unusual to the Bristol region, among which are several interesting corals and a goniatite.

The Tanhouse Beds, as we shall call the horizon, outcrop beneath Tanhouse Farm and were until quite recently quarried on the opposite side of the road immediately south of the house. Work has now been discontinued and the excavation which extended for nearly 400 yards in a southerly direction is now flooded. Tanhouse Farm lies a mile and a half N. 5° E. of Yate Church and stands on the north side of the lane of the same name which, running westwards, leaves the Chipping Sodbury-Wickwar main road two miles north of the former place (Ordnance Survey 6" Map—Gloucestershire, Sheet LXIX).

The beds exposed were:—

		ft.	in.
8	Quartzose grit much shattered and yielding only plant remains	Several feet	seen
7	Sandy shales with thin bands of sandstone	4	0
6	Limestone. <i>Chonetes hardrensis</i> very abundant	2	0
5	Calcareous shales	3	0
4	Limestone crowded with simple zaphrentoid corals and containing <i>Pleurodictyum</i> (" <i>Michelinia</i> ") <i>egertoni</i>		9

3	Calcareous shales, <i>Lingula</i> and <i>Phillipsia</i> common	..	..	1	4
2	Bluish sandy limestone	..	..	4	2
1	Fine splintery grit. Brachiopods are fairly numerous but occur mainly as casts. This bed is well exposed in Tanhouse Lane	..	..	..	Several feet seen

Most beds have yielded some fossils.

The strata dip 20° to 25° westwards and therefore, unless strike faulting occurs in between, and of this there is no evidence, they must lie some 500 to 600 feet above the limestone sequence, the highest part of which belongs to the Lower *Dibunophyllum* Zone—DI—and is quarried at Bury Hill a quarter of a mile due east.

The fossils collected in the Tanhouse Quarry have been identified as follows :—

Pleurodictyum (" *Michelinia* ") *egertoni* Edwards and Haime
Zaphrentis sp. nov.

Fasciculophyllum near *F. carruthersi* Hill

Caninia cornucopiae Michelin

Lingula squamiformis Phillips

Rhipidomella michelini (l'Eveille)

Orthotetes (*Schellweinella*) cf. *crenistria* (Phillips)

Chonetes cf. *hardrensis* (Phillips)

„ sp. cf. *dalmaniana* de Kon.

Productus sulcatus Sowerby

„ *pugilis* (Phillips)

„ (*Linoproductus*) *undatus*

„ (*Eomarginifera*) *setosus*

Composita ambigua (Sowerby)

Brachythyris sp. cf. *integricosta* (Phillips)

Athyris planosulcata (Phillips)

Punctospirifer sp.

Spirifer wickensis Vaughan

„ *duplicicostatus* Phillips

Neoglyphioceras sp.

Trepostomatous Bryozoan

Phillipsia eichwaldi Fischer v. Waldheim var. *mucronata* M'Coy
Selachian palate tooth

The corals, most of which belong to a single species which I identified with *Fasciculophyllum carruthersi* Hill, and is new to the region, are mainly if not entirely restricted to Bed 4, but in this thin band of limestone they are exceedingly abundant. The commonest brachiopods are *Chonetes* cf. *hardrensis* and *Eomarginifera setosa*. *Athyris*

planosulcata is fairly plentiful in Bed 1 and *Lingula squamiformis* is not uncommon in Bed 3, in which pygidia of *Phillipsia* are also numerous.

While it may not be possible yet to fix the precise horizon of the Tanhouse Beds or to correlate them definitely with any particular known bed in the arenaceous series, such evidence as they afford points to a position above "D2." However, before we can discuss this question it is necessary first to consider the highest part of the Avonian sequence at Bristol and Wick. The limestone of the Avon Gorge includes both the lower part (D1) and most of the upper part (D2) of the *Dibunophyllum* Zone. Reynolds, 1921, p. [242] has assigned 114 feet of limestone and 70 feet of grits and shales to the latter. Higher in the arenaceous series are some gritty limestones which Vaughan, 1905, pp. 186, 199 designated 'Horizon ϵ .' These beds are not seen in the Gorge but they were formerly exposed in St. Vincent's Parade, Clifton, and underlie the Victoria Rooms. The horizon is characterised by *Buxtonia scabriculus* and lamellibranchs. The same beds were also exposed on the Tyndall Park Estate in the vicinity of Woodland Road not far from the University where the "Millstone Grit" was once extensively quarried, and their fossils were described by Austin nearly eighty years ago (1865). Following the Lower Carboniferous rocks northwards, arenaceous conditions are found to set in at progressively earlier horizons, until at Bury Hill, the highest part of the limestone sequence lies entirely within the Lower *Dibunophyllum* Subzone—D1; see Tuck, 1925.

At Wick which lies on the same side of the coalfield as Bury Hill and Tanhouse, but seven miles further to the south, the arenaceous series and their calcareous intercalations are better exposed than anywhere else in the Bristol district and numerous old quarries and natural exposures have afforded good opportunities of collecting fossils. The succession down to the base of "D1" is, if my estimations are correct (Smith, 1930, p. 333):—

		Approximate thickness					
Coal Measures, lower part }	Grits and shales	..	..	..	..	..	470 feet
	(Presumed non-sequence)						
D3	{ Pebbly grit	..	..	..	..	..	30 "
	{ Mollusca Band	..	..	..	..	..	3 "
	{ Grits and shales	..	..	..	..	..	250 "
	{ <i>Chonetes polita</i> Limestone	..	..	..	..	..	30 "
	{ Grits and shales	..	..	..	..	..	200 "
D2	{ <i>Spirifer Wickensis</i> Limestone	..	..	..	..	..	75 "
	{ Grits and shales	..	..	..	..	..	90 "
D1	Top of main limestone	..	..	..	..	..	225 "

The beds I have placed in "D3" are clearly equivalent to Vaughan's Horizon ϵ . *Buxtonia scabriculus* and lamellibranchs are abundant in both the "Mollusca Band" and in the "*Chonetes polita* Limestone" but more particularly so in the former, which has produced a rich and interesting lamellibranch-gasteropod fauna. In the *Chonetes polita* Limestone, the tiny brachiopod after which I named the bed is exceedingly common. The *Spirifer Wickensis* Limestone yielded a good suite of characteristic "D2" corals and brachiopods. The fauna of the Tanhouse Beds differs from that obtained from any of the calcareous horizons just mentioned and agrees more closely with a small assemblage of forms collected from a thin series of gritty limestones which outcrops on the eastern side of the Wick inlier among the overturned arenaceous beds which have been thrust against the limestone mass. As the name implies, trilobite pygidia were conspicuous fossils in these beds, a species of *Lingula* (*L. mytiloides*) is present, and there were several brachiopods common to both it and to the Tanhouse Beds. One cannot identify the *Phillipsia* Band positively with either the Mollusca Band or with the *Chonetes polita* Limestone, but while it is almost certainly not the former it may very possibly be the latter, in spite of a difference in its fossils. Both limestones have the same mottled and, when weathered, the same pitted appearance. The calcareous beds at Tanhouse may also very well represent the same horizon. It is true that they occur at approximately the same distance above the top of "D1" as does the Mollusca Band but since the arenaceous facies set in considerably earlier at Bury Hill than at Wick this coincidence can have no stratigraphical significance.

The occurrence of the goniatite *Neoglyphioceras* sp. in Bed 4 definitely fixed the age of the Tanhouse Beds as Viséan and places them in the upper part of the *Posidonomya* Zone—P2 = D3 *partim*, lower part. The upper limit of D3 has never been accurately defined in terms of Bisat's Goniatite Zones. The horizon corresponds to the *Posidonomya* Zone P1 and P2 (Viséan) plus the *Eumorphoceras* Zone E1 and E2 (Namurian).

F. B. A. Welch, 1931, p. 303, has described a "D3" fauna from some beds near Stoke Lane, on the Eastern Mendips, very similar in its composition to that of the *Phillipsia* Band and *Chonetes polita* Limestone.

PALÆONTOLOGICAL NOTES

Pleurodictyum egertoni (Edwards and Haime)

PLEURODICTYUM Goldfuss, 1829

GENOHOLOTYPE :—*P. problematicum* Goldfuss, p. 113, pl. xxxviii, fig. 18a-g. Lower Devonian, Germany.

DIAGNOSIS :—Cerioid Tabulate corals with typically large corallites, thick, often spongy walls, short acanthine septa (frequently obsolete), tabulæ which are usually incomplete and distally arched, and large mural pores.

REMARKS :—I include in *Pleurodictyum* those Carboniferous Tabulate corals generally known as *Michelinia*. Lang, Smith and Thomas, 1940, p. 85, consider the genotype of *Michelinia* de Koninck, 1841, p. 29, *M. tenuisepta* (Phillips) de Koninck, 1841, p. 31, pl. C, fig. 3a-b, Lower Carboniferous, Belgium (non *Calamopora tenuisepta* Phillips, 1836, p. 201, pl. ii, fig. 30), to be congeneric with that of *Pleurodictyum*, and the genera therefore to be synonymous. For particulars see Smith, 1941.

Pleurodictyum egertoni (Edwards and Haime)

*Beaumontia*¹ *egertoni* Edwards and Haime, 1851, p. 276 ; 1852, p. 160, pl. xlv, fig. 1.

A solitary colony of this species, a foot or so in diameter and about nine inches high, occurring in positions of growth was found in Bed 4 in association with *Fasciculophyllum* near *F. carruthersi* Hill, *q.v.*, p. 343. *Pleurodictyum egertoni* forms large, irregularly hemispherical coralla of tall, slender, straight or slightly flexuous, separable, prismatic corallites typically 6 to 7 mm. in diameter. The corallite walls, which for *Pleurodictyum* are very thin, are transversely striated. The tabulæ are somewhat distant, but unevenly spaced, and in many cases complete, horizontal and almost flat ; others, however, are inclined and arched. Septa are obsolete. Contrary to Edwards and Haime's assertion, mural pores are present although they may not be everywhere seen.

¹ The genus *Beaumontia* Edwards and Haime, 1851, pp. 154, 276. Genosyn-types—*B. venelorum* Edwards and Haime, 1851, pp. 154, 276, pl. xvi, figs. 6, 6 a-b, Lower Devonian, France, *B. egertoni*, Lower Carboniferous, Ireland and *Columnaria laxa* M'Coy, 1849, p. 122 ; 1851, p. 92, pl. iii c, fig. 11, Lower Carboniferous, Derbyshire. Genoelectotype (see Lang, Smith and Thomas, 1940, p. 26)—*C. laxa*. Edwards and Haime believed these corals to have no mural pores. The holotype of *Beaumontia venelorum* is a recrystallized favositid and shows no structure and is quite useless as a type. *B. egertoni* is a characteristic cerioid species of *Pleurodictyum* very closely related to "*Michelinia*" *tenuisepta*, and *B. laxa* is also related to that species but is phaceloid. The type specimens of the last two species have, on being cut, proved to possess mural pores.

Edwards and Haime's figure illustrates the species fairly accurately although it is not, as the explanation of pl. lxx states, 'natural size.' The scale is reduced. The drawing, however, does not agree with the specimen in the form of the corallite cluster, yet certain details faithfully reproduced leave no doubt as to the identity of the type (specimen Geol. Soc. Coll. 5502—collected by Sir P. Egerton, Museum of Practical Geology). Either the specimen, as it now exists, is only part of the original¹ or, which is equally probable, the artist has drawn freely upon his imagination. (There are several cases of this in the *Monograph of British Fossil Corals* which have come under my notice.) The locality of the holotype is stated by Edwards and Haime to be "Sraccapagh, Fermanagh [Northern] Ireland" but there does not appear to be any such place. Prof. L. B. Smyth has been good enough to make very careful investigation into this matter but with negative results. The name is clearly a mistake or misreading of the original label.

REMARKS :—*Pleurodictyum* is common in the higher Tournaisian zones of the Bristol area and frequently appears in faunal lists under the generic name "*Michelinia*" but hitherto no species of the genus has been recorded from the Upper Viséan of the district.

Zaphrentis sp.

ZAPHRENTIS Rafinesque and Clifford, 1820

GENOLECTOTYPE (see Miller, 1889, p. 208) :—*Z. phrygia* Rafinesque and Clifford, 1820, p. 235. Middle Devonian, Falls of Ohio, U.S.A.

DIAGNOSIS :—Small, simple Rugose corals in which the major septa are pinnately arranged and their axial edges coalesce about a conspicuous cardinal fossula, the minor septa and dissepimentarium are not always present, and the tabulae are gently domed and generally incomplete.

REMARKS :—The above short diagnosis is framed so as to cover the Carboniferous forms at present included in the genus as well as the Devonian genotype. It is clear that these corals do not belong to a single lineage and that ultimately it will be necessary to transfer the Carboniferous species to other genera. There can be little doubt that most of them would be more correctly placed (as Schindewolf, 1938, has done) in *Zaphrentoides* Stuckenberg, 1895, pp. 38, 191—genolectotype (see Schindewolf, 1938, p. 449) *Zaphrentis griffithi* Edwards and Haime, 1851, p. 333 ; 1852, p. 169, pl. xxxiv, figs. 3, 3a, Lower Carboni-

¹ Dr. Stubblefield informs me there is another specimen (Geol. Soc. Coll. 5503). This may be part of 5502, but at time of writing this is not accessible for examination.

ferous, Clifton, Bristol. But before taking this important step, it is essential that the holotype of *Z. griffithi*¹ which is in the Museum of Natural History, Paris (No. Z.20A)² be re-examined and re-described. *Zaphrentis phrygia* has a narrow dissepimentarium, small, globose dissepiments, and carinae of the yard-arm type,³ and the distal edges of the septa are markedly serrate. The species is related and leads on to *Heliophyllum halli* Edwards and Haime, the genoholotype of *Heliophyllum* Hall in Dana, 1848, p. 356. The Carboniferous forms possess none of these characteristics, although in some, dissepiments of a less globose form may be present. On the other hand they often have a well developed stereozone. In most, if not in all, the tabulae are suppressed during the earlier ontogenetic stages of the coral by the lateral contiguity of the dilated septa. Hill, 1940, p. 124, in her diagnosis of *Zaphrentis*, mentions the tabulae as being "complete, horizontal or very gently domed" but this is hardly correct. They are very seldom quite complete although often nearly so and are always slightly convex.

Zaphrentis sp.

Fig. 7a-d.

Among the corals collected at Tanhouse was one of unusual shape and structure—a zaphrentoid form, which, it is almost certain, has not been described. Although one is very much tempted to give a name to the coral and thus to make the specimen the type of a new species, if not of a new genus, caution prompts the wiser course of deferring this step until European and Asiatic literature has been more thoroughly sifted and until more material is available to permit a wider selection in choosing a holotype.

The corallum, which is trochoid but laterally compressed, was 30 mm. in length, and its widest and shortest distal diameters were 22 mm. and 15 mm. respectively. The coral has been cut and several thin sections prepared from it. As in most other Rugose corals, the cardinal fossula lies on the convex side of the corallum, but in this

¹ The type—the only specimen known to Edwards and Haime—is a small turbinate coral about 25 mm. ("12 to 13 lines") high and slightly more in diameter. The calice shows cardinal and alar fossulae. The authors remark: "This species differs from all other known *Zaphrentis* in having its septal fossula centro-dorsal [i.e., on the convex side], two small lateral fossulae, and a short and broad form," whereas, as a matter of fact, it is very unusual for the cardinal fossula to occur as it does in *Z. delanouei* on the concave side. The three species of *Zaphrentis* common to the Tournaisian of the Bristol District are *Z. omaliusi*, Edwards and Haime, *Z. delanouei*, Edwards and Haime and *Z. konincki*, Edwards and Haime. No species have until now been recorded from the Viséan of the area.

² According to information supplied by Dr. Dorothy Hill.

³ All terms used in this paper have been defined by Hill, 1935.

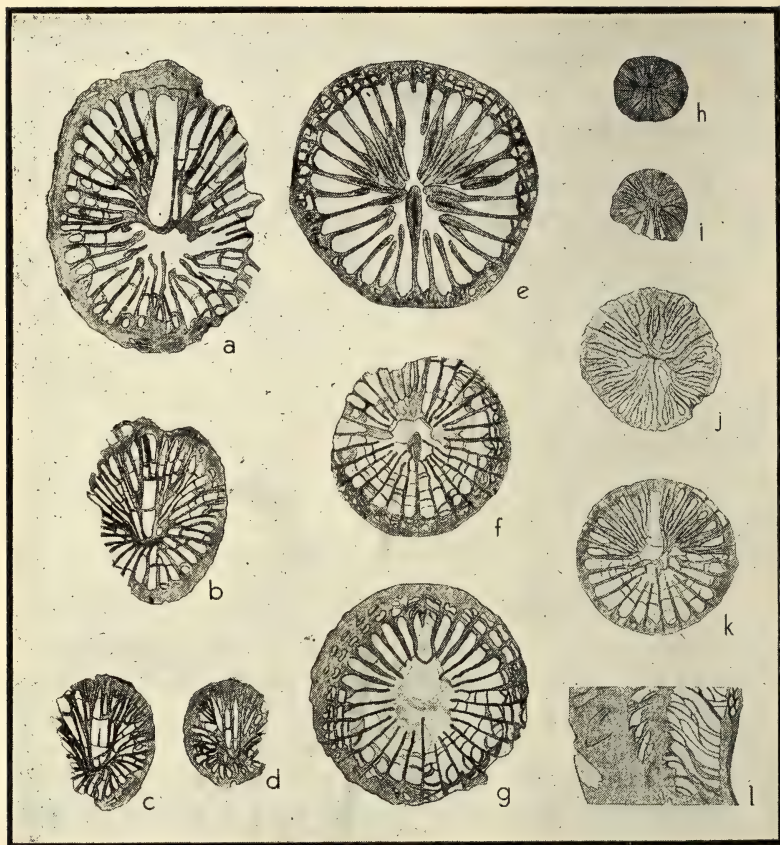


FIG. 7

CORALS FROM TANHOUSE NEAR YATE, GLOUCESTERSHIRE.

The figured sections, all enlarged 2.5, are in the City Museum, Bristol, and are registered under numbers quoted.

Zaphrentis sp.

Transverse sections: *a*. (Cb.2950) Ephebic stage. *b-d*. Neanic stages. *b*. (Cb.2952) Late. *c*. (Cb.2953) and *d*. (Cb.2954) Early.

Fasciculophyllum near *F. carruthersi* Hill

Transverse sections: *e-g*. Ephebic stage. *e*. (Cb.2956) Columella strongly developed, septa rhopaloid. *f*. (Cb.2957) Similar, but septa only feebly rhopaloid. *g*. (Cb.2958) Counter septa short and not axially dilated, septa hardly rhopaloid at all. *h-k*. Neanic stages. *h*. (Cb.2962) and *i*. (Cb.2961) Early. *j*. (Cb.2960) Later. *k*. (Cb.2959) Late, almost ephebic. Longitudinal section: *l*. (Cb. 2963).

form it is unusually long and occupies three quarters of the longest diameter of the transverse section. There are 46 major but no minor septa. During the neanic stages of the coral the fossula is occupied by a cardinal septum which is almost, if not quite, as long as the fossula itself (fig. 7, c-d) but as the coral approaches maturity, this septum diminishes gradually until in the ephebic stage it is only 1.5 mm. long (fig. 7, a). The septa in the cardinal quadrants are longer and slightly more numerous than those in the counter quadrants. Two particularly long ones define the fossula, and against these the others of the cardinal quadrants abut in all stages of coral growth except the ephebic stage. The septa in the counter quadrants at first converge and unite around the end of the fossula but, in the ephebic stage, the septa of both quadrants retreat peripherally, but not evenly so, and the short ones come to abut against their longer neighbours.

The characters of the transverse tissue and of the calice are not yet known.

Fasciculophyllum near *F. carruthersi* Hill

FASCICULOPHYLLUM Thomson, 1883

GENOLECTOTYPE (see Gregory, 1917, p. 238):—*F. dybowski*, Thomson, 1883, p. 449, pl. vi, figs. 23, 23a. Lower Carboniferous, Scotland. The syntypes of *F. dybowski* Thomson cannot be traced, and the genus, following Hill, 1940, p. 131, is here interpreted upon *Cyathopsis*? [sic] *eruca* McCoy, 1851,¹ p. 167; 1851,² p. 90, Lower Carboniferous, Beith, Scotland. Lectotype—see Hill, 1940, p. 132—Sedgwick Museum specimen A2183a.

DIAGNOSIS:—Small ceratoid and trochoid Rugose corals in which the counter septum is prolonged beyond the axis, and the axial ends of this and other septa are often strongly dilated, minor septa are poorly developed, the tabulae are incomplete and strongly arched and there are no dissepiments.

REMARKS:—See Hill, 1940, pp. 130-132. Since the genus has been considered at some length in the work quoted it is only necessary here to draw attention to the fact that there are a number of small Upper Palaeozoic corals in which the prolonged counter septum is axially dilated to form a columella. *Fasciculophyllum* may, it is true, as Hill has pointed out, prove to be synonymous with *Lophophyllum* Edwards and Haime, 1850, p. lxvi—genoholotype *L. Konincki* Edwards and Haime, 1850, p. lxvi; 1851, p. 349, pl. iii, figs. 4, 4a, Lower

Carboniferous, Belgium, but it is more probable that the two are homæomorphous.

Fasciculophyllum near *F. carruthersi* Hill

Fig. 7, e-l

cf. *Fasciculophyllum carruthersi* Hill, 1940, p. 134, pl. vii, figs. 57-62

The form, as I have previously indicated, occurs in Bed 4 in large numbers. The corals appear to have been to some extent sea-worn and corroded before they were incorporated in the calcareous sediment. The individuals vary widely in trivial details yet clearly belong to one and the same species.

The corallum is in all cases curved but in some more so than in others. It may be much wrinkled by transverse irregularities or it may almost be free of rugosity. Few specimens exceed 25 mm. in length or 10 mm. in distal diameter although there are some which are as much as 30 mm. long and attain a diameter of 14 mm. The calice is not generally well preserved and is usually filled with extraneous matter. It is moderately deep and has steep walls and a concave floor. There are approximately 30 major septa. In the ephobic stage only the counter septum reaches the axis, the others terminate a short distance from it. The arrangement of the septa is clearly pinnate. The cardinal fossula lies on the convex side of the corallum and is occupied by a very short cardinal septum rarely more than 2 mm. long. The counter septum usually extends beyond the axis and its end is generally, but by no means always, dilated to form a columella. Other septa, though more particularly those in the cardinal quadrants, may also expand axially and thus assume a rhopaloid or club-shaped form (fig. 7, e). But individual corals vary considerably in the form and degree of septal dilation. In some there is hardly any at all (fig. 7g), in others the septa are thickened throughout, while in others again swelling is localized to their axial or peripheral parts. The alar septa lie nearly at right angles to the line of symmetry through the cardinal and counter septa and thus the number of septa in the cardinal and alar quadrants is almost equal. The minor septa are rarely more than 1 mm. long and do not appear in transverse section until the coral has almost reached maturity. The tabulæ are close together, usually incomplete and nearly always strongly arched. Dissepiments, where present, are distinctly large and elongated but form only a narrow dissepimentarium. Throughout the neanic ontogenetic stages of the coral, transverse tissue is almost or completely suppressed by the vertical

elements—the septa (fig. 7, i-j), which at this stage are very much dilated, wedge-shaped, are more or less in lateral contiguity and usually reach the axis.

In size and in general shape the corals from Tanhouse agree with the typical *F. carruthersi* from the Middle Skateraw Limestone near Dunbar (East Barns or Skateraw). The two, however, differ in certain structural details. In the Scottish form, according to Hill, the counter septum does not swell out to form a columella, minor septa and dissepiments are absent, and the tabulæ are generally more complete and flatter. But, as I have pointed out already, the individuals from Gloucestershire vary considerably, and there are some which certainly agree very closely with Hill's description of the species. The one may well be considered to be a variety of the other. *Fasciculophyllum eruca* M'Coy, with which most of the Tanhouse forms appear to agree even more closely in details of structure, is a smaller, more cylindrical coral.

Neoglyphioceras sp.

NEOGLYPHIOCERAS Bruening

Up to the present, surprisingly few goniatites have been found in the Bristol neighbourhood, and those which have been recorded have been obtained from the Coal Measures. It is therefore encouraging to be able to record a species of *Neoglyphioceras* (Bruening, 1923, p. 264) from the Tanhouse Beds. The specimen, Cb. 2949, City Museum, Bristol, is only a small one—10 mm. in diameter, and is so poorly preserved that it has not been possible to determine the species. The importance of this cephalopod lies in the fact that it sets at rest any doubts that many exist concerning the age of Vaughan's "Horizon ϵ " and confirms the opinion that the "Millstone Grit" ranges in time from Viséan to Westphalian.

ACKNOWLEDGMENTS

I cordially thank those to whom I am indebted for help: Mr. S. W. Bisat for naming the Goniatite, Miss Glenys H. Peregrine for her assistance in preparing and examining coral sections, and Dr. H. M. Muir-Wood for checking and correcting my determination of some of the brachiopods.

I should like to take this opportunity of thanking Dr. C. J. Stubblefield for lending me on a previous occasion the figured type of *Beaumontia egertoni* preserved in the Museum of Practical Geology

(Geological Survey) and for his permission to cut the specimen, and also I must add Prof. L. B. Smyth, Trinity College, Dublin, for the great trouble he took in trying to trace the name 'Sracrapagh.'

The cost of publication has been partly defrayed by the University of Bristol Colston Society.

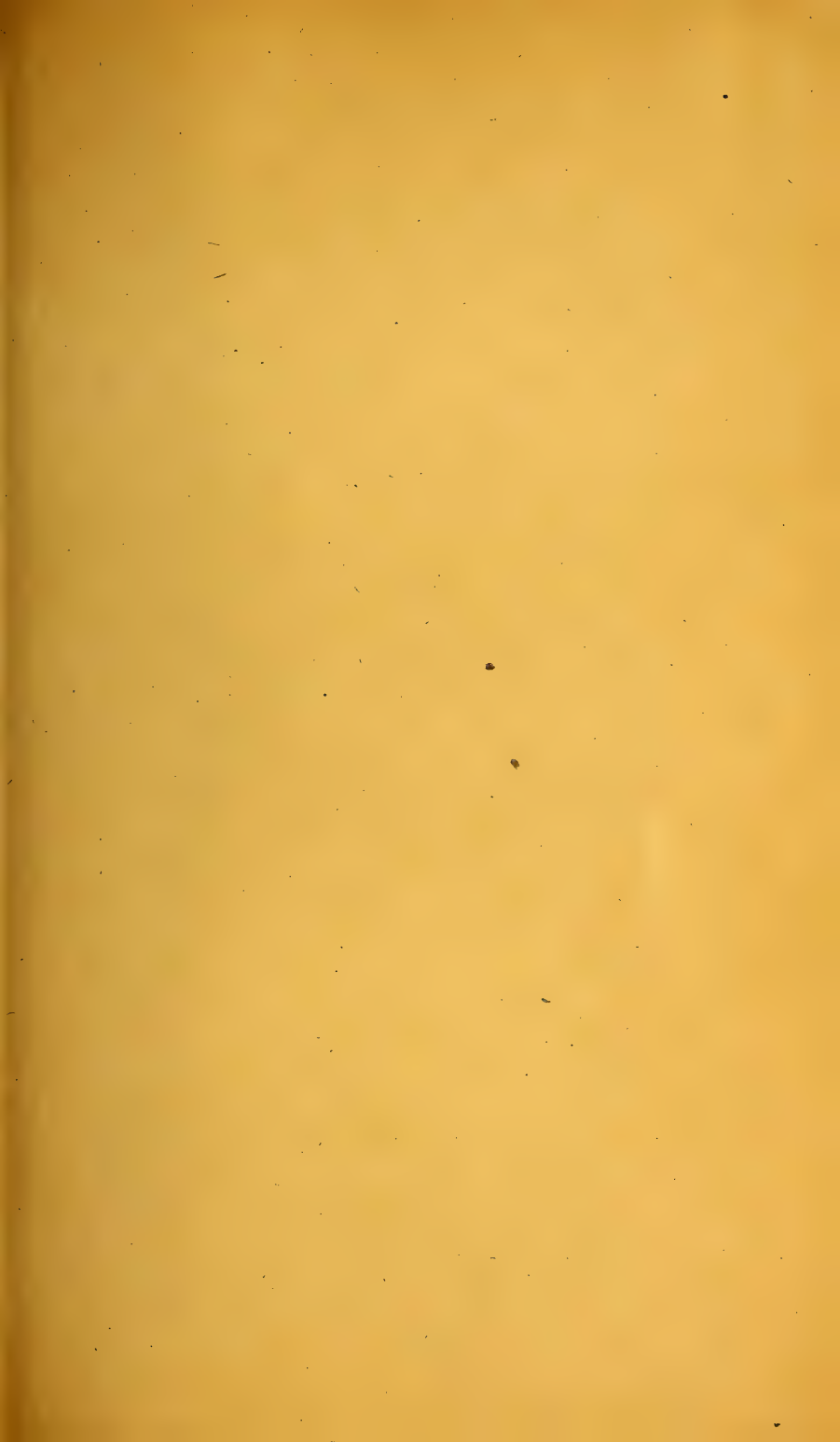
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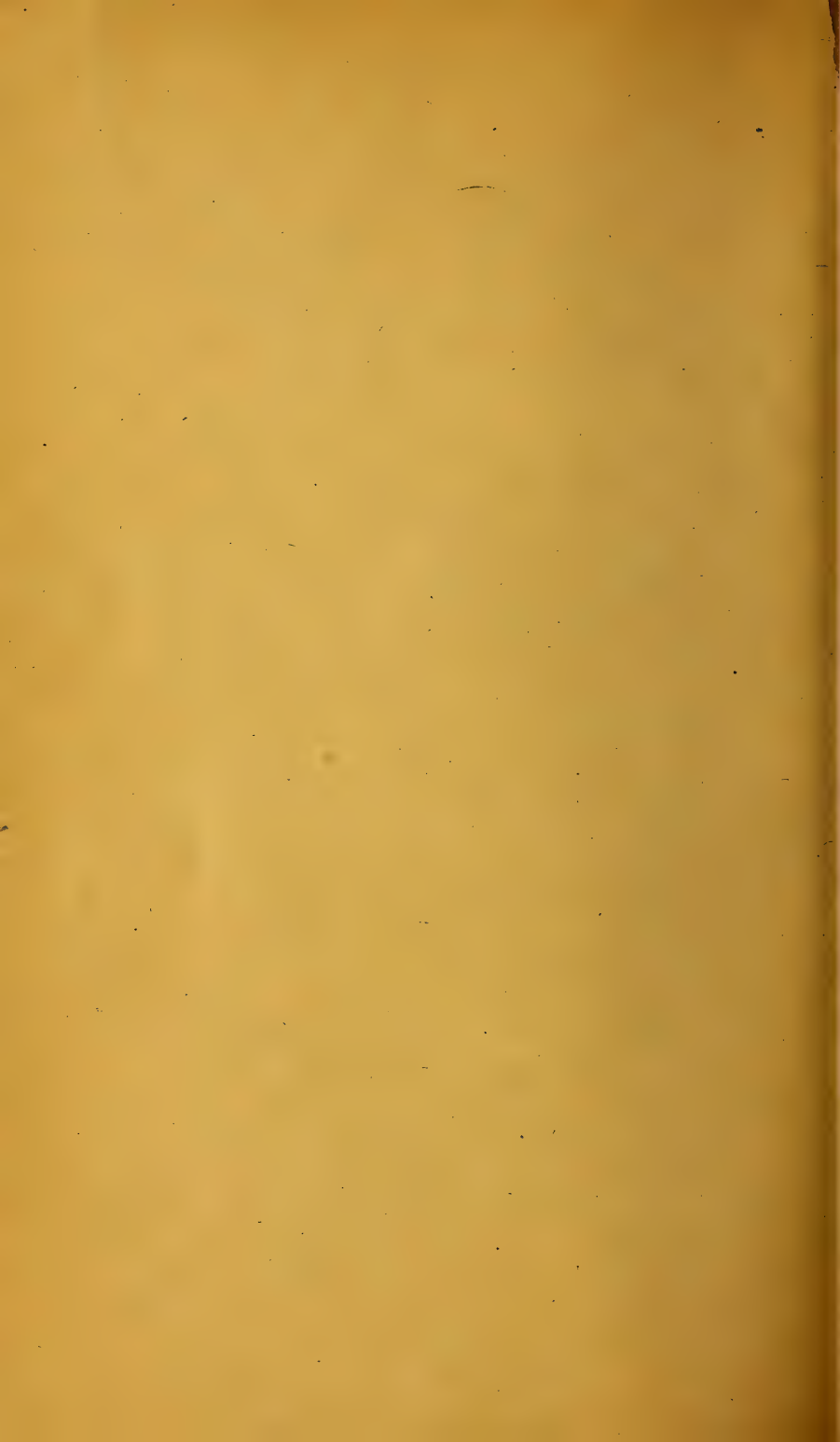
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PART IV.

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1942

PROCEEDINGS

OF THE

Bristol Naturalists' Society

EDITED BY H. W. TURNER, M.A., F.G.S.

ASSISTED BY A COMMITTEE



"Rerum cognoscere causas."—Virgil.

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AT THE BURLEIGH PRESS, BRISTOL

Issued July 16th, 1943

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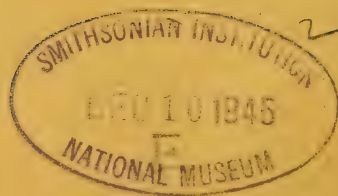


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All Books, Pamphlets, Reports of Proceedings sent by way of exchange, gift or otherwise, and all correspondence relating thereto and to purchases of the Society's publications should be addressed to :—

HON. LIBRARIAN, BRISTOL NAT. SOC.,
THE MUSEUM AND ART GALLERY,
BRISTOL, 8.

All matter for inclusion in the current issue of the *Proceedings* should reach the Hon. Editor :—

H. W. TURNER, M.A., F.G.S.,
THE UNIVERSITY,
BRISTOL, 8.

NOT LATER THAN JAN. 31, or insertion may be impossible.

The SOCIETY'S LIBRARY in the Bristol Museum and Art Gallery is open to members as under :—

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On other Weekdays - - - - - 10.0 a.m. to 6.0 p.m.
On Sundays - - - - - 2.30 p.m. to 5.0 p.m.

N.B.—The Library is temporarily removed from Bristol.

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MISS M. D. HILEY,
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F. W. EVENS, A.C.A.

HON. SECRETARY :

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Prof. W. F. WHITTARD, D.Sc., Ph.D., F.G.S.	

MEMBERS

As a measure of economy, the full list of members is not printed.

New Members

A = Associate. J = Junior. B = Botanical Section. F = Field Section.
G = Geological Section. O = Ornithological Section.

1942

<i>J.</i>	Alley, R. E.	.. ..	23 Trelawney Road, Bristol, 6	<i>O.</i>
<i>J.</i>	Arthur, Miss R.	.. ..	19 Clifton Wood Road, Bristol, 8	<i>F.O.</i>
	Fowler Miss A.	.. ..	28 Pembroke Road, Bristol, 8	<i>G.O.</i>
<i>J.</i>	Hesketh, E. J.	.. ..	29 Charminster Road, Fishponds, Bristol	<i>G.</i>
<i>A.</i>	Loupekine, I. S.	.. ..	18 Abbotsford Road, Bristol, 6	<i>G.</i>
<i>J.</i>	Oakes, Miss B.	.. ..	22 Crescent, Henleaze, Bristol, 9	<i>F.O.</i>
	Parsons, C. R.	.. ..	H.Q. 40 Group, R.A.F., Andover, Hants.	
<i>J.</i>	Skinner, D. M.	.. ..	Westacres, Brentry Hill, Bristol	<i>O.</i>
<i>J.</i>	Skinner, R. A.	.. ..	Westacres, Brentry Hill, Bristol	<i>O.</i>
	Smithson, Miss E.	.. ..	27 Redland Hill, Bristol, 6	<i>B.</i>
<i>J.</i>	Spink, Miss W.	.. ..	Downesway, Falcondale Road, Westbury-on-Trym, Bristol	<i>F.O.</i>
<i>J.</i>	Tadd, A. D.	.. ..	18 Fitzgerald Road, Bristol, 3	<i>O.</i>
<i>A.</i>	Walters, S. M.	.. ..	Winford Hospital, near Bristol	<i>B.</i>

1943

<i>J.</i>	Bedford, J.	.. ..	Wills Hall, Bristol, 9	<i>B.O.</i>
<i>J.</i>	Martin, A. B.	.. ..	90 North Road, Bristol, 6	<i>G.</i>
<i>A.</i>	Nussbaum, M.	.. ..	29 St. Pauls Road, Bristol, 8	<i>G.</i>
	Taylor, Miss A. E.	.. ..	16 Cotham Road, Bristol, 6	<i>O.</i>
	Warne, L. G. G., M.Sc., Ph.D.		Botany Dept., Manchester University	
<i>J.</i>	Williams, H.	.. ..	4 Hurle Road, Bristol, 8	<i>G.</i>

REPORT OF COUNCIL

to 31 December, 1942

AS in the previous war years it has not been deemed advisable during 1942 to institute a progressive policy with regard to administration or meetings. However, the Society and its Sections have maintained their existence, even slightly improved their membership, and the close of the year shows no diminution in interest.

It is with deep regret that we record the death of Miss B. B. Macpherson, an Ordinary Member and one who had been keenly interested in botanical activities.

Council wish to record their congratulations to Professor A. E. Trueman, who has been elected a Fellow of the Royal Society.

Owing to black-out conditions, meetings have been held on Saturday afternoons, although advantage was taken of the Spring and Autumn to arrange meetings in the early evening.

At the Annual General Meeting in January, Mr. H. Tetley, B.Sc., succeeded Professor Macgregor Skene as President, and Professor C. M. Yonge was elected a Vice-President.

It was with regret that, in March, members received the resignation of Sir Ernest Cook, D.Sc., as Honorary Auditor. He was unanimously thanked for his services which had extended over many years.

The Annual Field Meeting organised by the Field Section was held on Saturday, 27 June, when Mr. Ivor Evans led the party to Hampton Rocks and the Botanical Gardens, Bath. Members of the Bath Natural History Society also joined the meeting.

Once again your Council would take this opportunity of thanking members for their continued loyalty to the Society under the present difficult and strenuous conditions.

M. DORIS HILEY, *Hon. Secretary.*

The Hon. Treasurer in Account with the Bristol Naturalists' Society

Dr.

RECEIPTS AND PAYMENTS FOR THE YEAR ENDING 31st DECEMBER, 1942.

Cr.

1941	£ s. d.	To Members' Subscriptions :— Life Ordinary : 1940 " 1941 " 1942 " 1943 (half-year) Associate : 1941 " 1942 Junior : 1942 Total Subscriptions	£ s. d.	£ s. d.
56 12 6	.. .. .	.. .. .	10 0 0	—
11 2 6	.. .. .	.. .. .	3 15 0	.. .. .
15 0	.. .. .	.. .. .	50 10 0	.. .. .
	.. .. .	.. .. .	5 0	.. .. .
	.. .. .	.. .. .	10 0 0	55 0 0
	.. .. .	.. .. .	9 10 0	.. .. .
	.. .. .	.. .. .	.. .. .	10 0 0
	.. .. .	.. .. .	.. .. .	1 5 0
68 10 0	Total Subscriptions	.. .. .	66 5 0	.. .. .
3 16 0	Sale of Publications .. .. .	.. .. .	3 9 3	.. .. .
94 7 0	Grants towards <i>Proceedings</i> .. .. .	.. .. .	38 14 2	.. .. .
10 6	Advertisements in <i>Proceedings</i> .. .. .	.. .. .	—	.. .. .
5 0 0	Grant for Bookbinding (Field Section)	.. .. .	—	.. .. .
2 11 8	Interest on Deposit in Post Office Savings Bank	.. .. .	.. .. .	.. .. .
174 15 2		.. .. .	108 8 5	.. .. .
22 15 0	Subscriptions to Sections per contra	.. .. .	22 5 0	.. .. .
73 4 3	Balance from last Account .. .. .	.. .. .	215 15 2	.. .. .
	Memo : Payments made during 1942 in respect of 1941 were :— S.W. Naturalists' Union <i>Proceedings</i> , 1940 Postages, etc., Hon. Secretary Leaving a true balance to 1942 of	 1 0 0 148 16 0 3 8 7 153 4 7 62 10 7 £215 15 2	.. .. . .. .. . .. .. . .. .. . .. .. .	.. .. . .. .. . .. .. . .. .. . .. .. .
270 14 5		.. .. .	£346 8 7	.. .. .

A. H. PEACH, *Hon. Treasurer.*
6th January, 1943.

Audited and found correct.
F. W. EVENS, Hon. Auditor.

Bristol, 12th January, 1943.

LIBRARIAN'S REPORT

1942

THE greater part of the Library, including runs of about one hundred and twenty journals and over one hundred single volumes, has now been evacuated from Bristol. In addition to the names mentioned in the last Report, the Society is greatly indebted to Dr. A. H. Campbell for agreeing to store three large book-cases filled with books. At the request of Council, a special first-loss Library Policy for Insurance against War Damage has been taken out in respect of the books and printed publications comprised in the Library.

Two additions to the Exchange List have been made during the year. From the Dorset Natural History and Archaeological Society the Library will receive the *Proceedings* of that Society, while the Caradoc and Severn Valley Field Club will send their *Transactions* and *Record of Bare Facts*.

The Society is indebted to Mrs. A. G. Bell, the Misses Bucknall, Mrs. H. Hosegood and Mr. H. Tetley for the presentation of books, and also to a number of other members for the return of copies of previous issues of the *Proceedings*. The usual journals have been received from the Botanical, Entomological, Geological and Ornithological Sections, and the *Zoological Record*, 1940, and Gurney's *Larvae of Decapod Crustacea* (Ray Society Monograph) were received by subscription.

Finally, a small number of books of no value to the Library has been disposed of in various ways, and it is hoped that this may help a little to ease the severe congestion that will certainly arise when the contents of the Library are returned to their shelves. Certain books belonging to the Bristol Microscopical Society, housed for some years in the Library, have been returned to their owners, and, with the sanction of the Library and Publications Committee, certain specialist publications and reprints were handed over to the University Library, and a number of duplicate or out-of-date volumes were disposed of as paper salvage.

H. GORVETT, *Hon. Librarian.*

REPORT OF BOTANICAL SECTION

1942

MEETINGS were started in March by a visit to the University gardens and greenhouses with Professor Skene. In April, Mr. Gordon Rowley read a paper on "Cacti and their peculiarities," showing many specimens from his collection. "Violas" was the subject of the May meeting, when forty-eight sheets were examined and discussed, though, unfortunately, fresh material was sadly missing. This, however, was plentiful for the next five months, when some interesting plants were brought in: e.g., *Lilium pyrenaicum*, *Salvia pratensis*, *Melampyrum cristatum*, *Orchis purpurea*, *Ophrys sphegodes* var. *fucifera*, *Acorus Calamus*, *Rumex scutatus*.

Some of the members concentrated through the summer on the "Sorbi," and Mr. Stuart Max Walters has identified a tree growing on both sides of the Avon Gorge as a new species which has been described, but not yet published, by Dr. E. F. Warburg.

In the autumn, papers were restarted. In November, Mrs. Bell read one on "The Coniferae," and also showed specimens of those commonly cultivated in the British Isles; and in December, Mr. Walters' subject was "Species and Variety," illustrated by herbarium specimens.

Spartina is gradually coming up the Avon, and in August was seen in flower just below the city.

We regret to report the death during the year of two former members, Miss B. B. Macpherson and Sergt. Observer R. F. Miles.

ETHEL M. E. BELL, *Hon. Secretary.*

REPORT OF ENTOMOLOGICAL SECTION

1942

THE 79th Annual Meeting was held on 6 February, 1943, in the B.N.S. Library. The President, Mr. J. W. Norgrove, and the Hon. Sec., Mr. A. H. Peach, were re-elected. The Hon. Secretary reported that, owing to the fact that some members were serving in the Forces and others were resident too far from Bristol to attend the meetings, only limited activities could be attempted. Four meetings only were arranged, when exhibits were on view.

On 23 May there was an excursion to Clevedon. Mr. Audcent had arranged for a ramble through the woods of Clevedon Court and across Cadbury Camp to Clevedon where we were entertained to tea by the kindness of Mr. and Mrs. Page of The Avenue. Members and friends numbered 10.

At the Annual Meeting a suggestion was made that it might help in fostering interest in the Section if a Field Meeting could be arranged with an Entomological leader. The Section has for very many years supplied the Society's Library with the *Entomologist* and *Entomologists' Monthly Magazine*, and, unless new members can be obtained, it does not seem possible to continue to supply these useful magazines, the price of which is equal to present subscriptions and leaves no margin for sundry expenses. An appeal is therefore made for new members so that this old Section may be able to continue. Please communicate with the Hon. Sec. (5, Hanbury Road, Clifton).

A. H. PEACH, *Hon. Secretary.*

REPORT OF FIELD SECTION

1942

THE war-time policy of the Section has now become standardised and in 1942 a similar type of programme was carried out to that of 1941. This included five general and three Botanical field meetings. The Section also publicised four field meetings arranged by the Geological Section and two by the Ornithological Section of the parent Society.

On 25 April Sir Lewis Fermor arranged a meeting at Failand, and on 30 May Mr. F. W. Evens conducted a party to Bourton Combe; Mr. Ivor Evans led the field meeting on 27 June to Hampton Rocks and Botanical Gardens, Bath; in July Mr. Edmonds led a party to Cribbs Causeway and Henbury and on 12 September he made arrangements for a field meeting at Whitchurch and Dundry. The attendance for the meetings averaged 14.

Three Botanical field meetings were held, namely, on 6 May at Brislington and Keynsham, led by Mr. Ivor Evans, and on 3 June and 1 July—left and right banks of the Avon led respectively by Mr. F. W. Evens and Mr. H. O. Edmonds.

We regret to record the death of Miss B. B. Macpherson who was for many years an energetic member of this Section. She kindly bequeathed to the library of the Section a copy of *The Bristol Flora* by J. W. White, F.L.S.

The membership now stands at 53.

M. DORIS HILEY, *Hon. Secretary.*

REPORT OF GEOLOGICAL SECTION

1942

DURING the year the Geological Section has continued to enjoy the services of its officers, Professor Gordon, Professor Whittard, Mr. Ashby, Mrs. Marsden and Mr. McMurtrie, while the other members of the Committee were Sir Lewis Fermor, Mr. Gunner, Mr. Hudson, Professor Reynolds, Dr. Stanley Smith and Dr. Wallis.

Two papers of special interest were contributed at the Annual General Meeting on 24 January, one, by Professor Reynolds, entitled "Reminiscences of some Bristol Geologists," the other, by the President, on "The Uses of Diamond in Industry."

On 14 February Mr. D. J. Smetham, Lecturer in Geography at King's College, London, presented an excellent first-hand account of the physiography of Finland.

At the Open Meeting on 14 March we enjoyed a particularly illuminating lecture by Dr. F. J. North, of the National Museum of Wales, entitled "Geology out of Bounds," which dealt particularly with applications of geological knowledge and technique to archæological problems.

Field excursions held during the summer were as follows :—

- 9 May. Coalpit Heath and Yate, led by Professor Gordon.
- 17 June. Wraxall, led by Dr. Smith.
- 11 July. Charfield, led by Mr. Hudson.
- 26 Sept. Farrington Gurney, led by Mr. Gunner.

Each of these excursions was favoured with good weather and well attended.

On 17 October Dr. Stanley Smith gave a fascinating lecture on "The Ancients' Knowledge and Use of Rocks and Minerals."

In a lecture on "Ripple Marks" on 14 November, Mr. I. S. Loupekine presented a commendable exposition of this complex subject.

We regret the resignation on leaving Bristol of Mr. N. A. F. Rowntree.

As new members we welcome Mrs. A. G. Bell, Miss A. Fowler, Messrs. E. J. Hesketh, I. S. Loupekine, M. Nussbaum and Masters A. B. Martin, A. D. Tadd, and H. Williams.

The membership of the Section is 70.

D. F. ASHBY, *Hon. Secretary.*

REPORT OF ORNITHOLOGICAL SECTION

1942



IT may be of interest to record here that the close of the 1942 programme marked the completion of the twentieth year since the revival of the Section. What has been achieved may be viewed in retrospect with some satisfaction, and at meetings, 115 in all, there have been many useful discussions and a variety of highly instructive lectures. Apart from a number of visits to Steep Holm, outdoor work has been due chiefly to individual rather than to organised effort and has included photographic expeditions, "ringing" and Heron counts, while from numerous observations along the Severn, at the North Somerset reservoirs and else-

where, much has been learnt of bird distribution in the Bristol area. Field work, however, should figure more prominently in the Section's activities and members may be reminded that the various Inquiries conducted by the British Trust for Ornithology deserve the utmost support and co-operation.

Members have met on five occasions during the present year and the attendance has been well up to average. At the *January* meeting Mr. R. P. Gait gave a good account of "Birds of the Scillies" and showed a first class selection of slides. Of these, many were from photographs taken by the lecturer during a visit in 1926 to the famous bird island of Annet. In *February* some fine colour slides were shown when Dr. C. F. Druitt spoke on "Bird-life in the Shetlands." In continuing his lecture at the *March* meeting Dr. Druitt exhibited a beautifully prepared series of skins including such species as Eider-Duck, Storm-Petrel, Arctic Skua, Black Guillemot and Little Auk. Of special interest among these was a number of immature and nestling specimens. Skins were also shown to illustrate differences between the mainland and Shetland forms of the Wren.

In *October* Mr. J. H. Savory, in speaking on "British Birds in Lore, Legend and Superstition," illustrated his lecture with a large number of slides. In addition to detailed accounts on weather-lore and ancient beliefs, a brief outline was given of the history of Swan-marks, and the old-time sports of Cock-fighting and Falconry were described. Finally, at the *November* meeting, the Secretary, in giving a lantern talk on "The Severn Geese and other Birds of the Estuary," dealt extensively with waders on the river mud-flats and geese on the Slimbridge New Grounds. An account was also given of the Berkeley Castle duck decoys. Slides were from photographs and pencil drawings by Mrs. H. H. Davis.

Among those who have supported the Wood-Pigeon Investigation, Mr. A. E. Billett has been particularly active in returning a large number of nest habitat cards. This investigation, in view of the present food production drive and the immense damage done to farm crops by wild pigeons, is of the greatest importance. That a census of breeding Herons at Brockley Combe and Banwell was again completed was largely due to so energetic a worker as Mr. H. W. Neal. Details of this and occasional observations at the reservoirs and other good bird haunts will be found later in this issue of the *Proceedings*.

In conjunction with the Field Section a few members took part in two evening field-walks—the first in Leigh Woods on April 29 and the second in Blaize Castle Woods on May 20.

Membership now totals 69 and, with a balance in hand of £5 19s. 9d., the Section's financial status continues to be satisfactory.

H. H. DAVIS, *Hon. Secretary.*

Account of the Annual and General Meetings

1942

THE 79th Annual Meeting of the Society was held in the Wigglesworth Library of the University of Bristol on Saturday, 17 January, when the President, Professor Macgregor Skene, was in the Chair. The reports of the Honorary Treasurer, Honorary Librarian and Honorary Secretary were read and adopted. The President spoke of the loss which the Society had sustained by the death of that eminent citizen Mr. W. Melville Wills and also of Dr. Rose Bracher and Messrs. Roger Ford and F. N. Reed. Mr. H. Tetley, B.Sc., was elected President and Mr. Ivor Evans and Professor C. M. Yonge Vice-Presidents. The remaining Officers were re-elected. Professor Macgregor Skene gave his Presidential Address, taking as his subject "Wheat and Germination." In thanking him, warm appreciation was expressed of the able manner in which he had dealt with the Society's activities during the past four years.

The 614th General Meeting was held on 26 March in the Wigglesworth Library with the President, Mr. H. Tetley, in the Chair. Mr. J. H. Savory gave a lecture on "Birds of Holland" and, in response to a notice in the local papers, about 12 Dutch folk were present.

The 615th General (Field) Meeting on 27 June at Hampton Rocks and Botanical Gardens, Bath, was led by Mr. Ivor Evans.

The 616th General Meeting was held on 1 October when Professor C. M. Yonge gave a lecture on "Shipworms and other Marine Boring Animals." The President was in the Chair.

The 617th General Meeting took the form of an Exhibition and was held in the Senior Botanical Laboratory of the University on Saturday, 7 November. The President, Mr. H. Tetley, was in the Chair.

M. DORIS HILEY, *Hon. Secretary.*

PRESIDENTIAL ADDRESS, 1942

(Read, Jan. 16, 1943)

Animals and their Surroundings

By H. TETLEY, B.Sc., F.Z.S.

IN talking to you this afternoon on the subject of "Animals and their surroundings," I shall restrict myself very largely to the two groups of Vertebrates on which I have worked most, i.e., Birds and Mammals.

To take geographical distribution first, there are evidently some deep-seated factors at work to cause the restrictions of some animals. Though at the present time the mammals of the British Isles and Africa are very different, yet in former days the discrepancies were fewer, for the Elephant, Lion, Hippopotamus, Rhinoceros and Hyæna, all very characteristic of Africa, occurred commonly in many parts of Britain. Their disappearance may be due to change in climate, though one must remember that in the frozen tundra of Siberia, Mammoths with a hairy coat have been discovered, so these animals may have lived in colder regions than they do now. But climate may not be the whole story. New Zealand has no native land-mammals except a Bat and a Rat which may have been introduced, but this is due to the islands' being cut off from the rest of the world before mammals were evolved, in about Triassic times. Many mammals have now been introduced and have flourished, so it cannot be a question of climate. Much the same is the case in Australia.

Bats can fly, so, in theory, they could easily pass from one country to another. Yet, while Normandy has 15 species, Britain has 12, Ireland 7 and Scotland not more than 6. This restriction seems to be due to a combination of climate and of suitable surroundings.

In tropical and sub-tropical seas occur commonly Frigate or Man-o-War birds (*Fregata*), large birds with a wing expanse of between six and seven feet, giving them magnificent sailing powers of flight. Yet, in spite of this, their range is highly restricted, and they have evolved into a number of very distinct types, no doubt due to long isolation. Penguins are flightless birds, confined to the Southern Hemisphere,

mainly in higher latitudes, though one species is found on the Galapagos Is. through which the Equator runs. Thus, on the west coast of South America they occur much further north than on the east. This is certainly due to the cold Humboldt current flowing up the west coast and reaching these islands. Temperature of the water is a very important factor with marine animals, and the colder water provides suitable conditions for the animals on which the Penguins feed. Regularly, about Christmas, and much more pronouncedly at much longer intervals, a warm El Niño current flows in from the north. When this is very strong, raising the temperature by 5° centigrade or more, the effect is striking. Many fish are killed, or leave the area, and thousands of sea-birds are destroyed by disease.

Many animals, therefore, are in niches from which they cannot escape. There they must stay and survive, if they can, or perish. I feel that this limitation may have helped in their extinction in some cases.

The Carolina Parakeet (*Conuropsis carolinensis*) formerly roamed over the eastern United States of America in huge flocks, but was destroyed in large numbers owing to the damage it caused to crops, though its original food was seeds of grass, thistles, etc. It bred in large colonies and is now quite extinct, but might have survived had it been able to extend its range, to keep to its original food and, above all, to get away from its colonial habits, meaning large numbers in a restricted area. And, though the factors were very different, much the same might have happened to the Great Auk (*Alca impennis*).

Now let me turn to variation in the animals themselves.

There are considerable individual differences, some being very susceptible to variation, others quite the reverse. In domestic animals, Cattle, Dogs and Pigeons belong to the former, and our domestic goose to the latter, this bird only varying from the wild Grey Lag Goose (*Anser anser*), its probable ancestor, in increased albinism and weight. In wild Mammals, the Mole (*Talpa europaea*) and Badger (*Meles meles*), though having a huge range, vary very little, whereas the long-tailed Field Mouse (*Apodemus*) varies enormously, no less than four or five species inhabiting Great Britain and Ireland. In Birds, the Lapwing (*Vanellus vanellus*), breeding from Ireland to Kamchatka, does not seem to vary at all, though one would think that the very different climatic conditions of Siberia, compared with those of Ireland, might have had some effect. In many wild duck the same thing

occurs, but here it may be that the intermingling of flocks in winter, followed by birds breeding far away from the area where they were hatched, may have prevented the production of any distinct character. On the other hand, the Song Thrush (*Turdus ericetorum*) and Crossbill (*Loxia*) are liable to variation, the former in the tone of its plumage which gets darker with an increase in the dampness of the climate, the latter in increasing strength of its bill, which may be due to increasing toughness of its food.

Where a species extends from south to north, the northern forms are larger than the southern. Thus, among Mammals, the Greenland Hare (*Boreolepus groenlandicus*) is one of the largest Hares in the world, though living in very high latitudes, and, in Birds, the Franz Josef Little Auk (*Alle a. polaris*) and Spitzbergen Puffin (*Fratercula arctica naumanni*) are both larger than the more southern types.

The Giraffe and Zebra are puzzling for, though living in similar surroundings in Africa, the effect on their colouration has been different. The Giraffe is more marked in the south than it is in the north, while the reverse is the case with the Zebra.

Such examples as I have given show some of the problems, and the solutions I have offered are, of course, only tentative, unsupported by detailed experiment which would be difficult in many instances.

Surely, the answer would lie in detailed work in some restricted area, work suitable for a local natural history society. The great scientist, Charles Darwin, pointed out in the *Origin of Species* the interdependence of clover, humble-bees, field-mice and the animals that prey on the mice. Thus the Geology, on which abundance of clover depends, Botany and Zoology are all interwoven, and a detailed study of some area may well give us valuable data on which to build up factors connecting animals with their surroundings.

Bristol Botany in 1942

BY CECIL I. SANDWITH

(Received, Feb. 11, 1943)

THE year 1942 has proved to be one of great difficulty for the field botanist, and observations have been confined to a limited area. Material needs for the moment seem to have triumphed over production of food for the mind. Nevertheless, it has been possible, even in a garden, to observe the stealthy encroachment of unusual intruders along with the weeds: small trees, an inch or two high, of Elm, Ash, Hazel, Elder, Maple, Hawthorn and Oak, seedling plants of Ivy and *Clematis Vitalba*, which, if left to colonise, would, in a few years, transform the garden into a woodland. Nature works so secretly that it is difficult to suspect such small plants of having already produced formidable roots underground, but the habit of the Oak is to be eternally fixed, whereas the unstable Elm is often uprooted in a gale, and the rooting system of these two trees in the early stage is entirely different.

It is usual in the spring to watch the Oak and Ash trees. This year there was no competition: Oak trees in the district were in leaf and flower when the Ash remained bleak and bare. One missed the purple clusters and 'the keys' and wondered, "Why?". This, however, seems to have been general and was observed by two Yorkshire naturalists in different districts: Mr. E. R. Cross carefully examined the Ash trees near Scarborough and "Could not find a single fruit," while Mr. E. G. Highfield from Pickering observes that "Trees were late in getting into leaf, especially the ash, which was quite bare up to the second week in June." He adds that from his observation "it has not been a healthy season for trees." Miss Bowen noticed that the three Hornbeams on Redland Green had lost their leaves in July and appeared to be dead. The two trees of *Ulmus Plotii* in Clifton were quite bare this spring when the surrounding Elms were green, and it was surprising in the autumn to notice that, although they came into leaf so late, they had again lost their leaves and assumed their winter aspect while the other Elms were still in full leaf. Whether

this was seasonal or characteristic of the species needs further observation.

Mr. Ivor Evans records several trees of Elm (*Ulmus procera*?) with variegated foliage in West Town Lane, Brislington.

Miss Jill Tetley observed a tree of *Arbutus Unedo* flowering in December near The Gully, Clifton. This may have been a young tree, bird-sown, as it does not appear to have been noticed before. There are many large old trees of *Arbutus* planted about Clifton: the one in Cecil Road was flowering profusely in January, and I am told this tree often flowers twice in the year.

It is curious to note that, although certain trees seem to have been affected adversely, the fruit crops did not suffer and it was a remarkably good season in most places.

Calendulas self-sown from a previous year's crop in the garden produced a high percentage of abnormal 'freak' specimens, 20 being noted in a small area.

Corydalis claviculata (L.) DC. Discovered in quantity in another station near Iron Acton, G., by Mr. Ivor Evans. This is welcome since the plant has become extremely scarce in the original locality.

Cochlearia officinalis L. Roadside a short distance S.W. of Beacon Farm near Shepton Mallet, S., J. P. M. Brenan. Probably an introduction in so unlikely a habitat.

Viola odorata L. var. *subcarnea* (Jord.) Parl. Plentiful along a roadside bank near Nettlebridge, S., J. P. M. Brenan.

Rosa canina L. var. *aspernata* (Déségl.) Briggs. A bush in a hedge close to Meare village, S., C. and N. Sandwith.

Cirsium acaule (L.) Weber $\times$ *palustre* (L.) Scop. Dr. W. A. Sledge writes that this is the correct identification, in his opinion, of the interesting hybrid Thistle collected by Miss Roper in a rough field at Failand, S., in August, 1914. The material was sent to the Watson Exchange Club and was identified by the late Rev. E. S. Marshall as *C. acaule* $\times$ *arvense* (see *Rep. Wats. Exch. Cl.* ii. 498 (1915)); and the record appeared under the latter name in Mr. J. W. White's Notes Supplemental to the Flora of Bristol, in *Journ. Bot.* lvi. 44 (1918). Dr. Sledge adds that he has seen another gathering of *C. acaule* $\times$ *palustre* from our district:

Babington collected it in August, 1851, between Wells and Shepton Mallet, S., and the specimens—labelled *Cnicus dubius* Willd.—are in his herbarium at Cambridge, while the gathering is mentioned as “a singular branching thistle, allied to *Carduus acaulis*” in his *Journals and Correspondence*, p. 159 (edited 1897). Babington collected his plant in the course of a walk from Wells to Dulcote Church Hill and found “the same the next day at North Wootton, but cut down.”

Veronica agrestis L. Garden-weed, Field Farm, Shepton Mallet, S., J. P. M. Brenan.

Euphrasia confusa Pugsl. forma *albida* Pugsl. Pasture, Burnham, S., A. E. Wade, see *B.E.C.*, 1939 *Exch. Rep.* p. 422 (1942).

Orobanche Hederae Duby. Washingpool Hill, Tockington, G., Dr. David Prowse.

O. minor Sm. Below Hackett Hill, between Thornbury and Milbury Heath, G., Dr. David Prowse.

Thymus glaber Mill., sens. Ronniger. Among stones and grassland by track leading from Wookey to Ebbor Rocks, S., Dr. J. N. Mills and J. P. M. Brenan.

Spartina Townsendi H. and J. Groves. The arrival of this Cord Grass in West Gloucestershire was described by Miss Ida Roper in *Proc. Bristol Naturalists' Society*, 1923, p. 49, when small clumps of *Spartina* were reported on the muddy shore of the Severn, near Severn House Farm. In 1930 the *Spartina* had reached Avonmouth, and small patches were noticed on the mud some distance beyond the Docks but within the dock area, see *B.E.C.* 1930 *Rep.* p. 376 (1931), and 1932 *Rep.* p. 359 (1933). Photographs were taken, and in 1932 the Grass was established and increasing. Mrs. Bell's observation of the extension of *Spartina* up the Avon this year is of great interest. She found that it was established by the river-side below Portway, opposite the entrance to the tunnel of the railway from Avonmouth to Clifton Down.

× *Alopecurus hybridus* Wimm. (*A. geniculatus* L. × *pratensis* L.) In quantity in the corner of a pasture on Tickenham Moor, S., C. and N. Sandwich. The first record for the district.

Polypodium vulgare L. A remarkable sport with the median pinnae of each frond deeply pinnatifid was found on Tor Hill, Wells,

S., by *J. P. M. Brenan*, who writes, "It agrees with specimens, descriptions and illustrations of what has been called var. *semilacerum* Link; it appears, however, to be merely a teratological variant. I visited the plant in April and September but saw no sign of the formation of *sori* on either occasion."

ALIENS. *Corydalis cava* (L.) Schweigg. et Körte. Stinchcombe, G., *C. Thomas*, see *B.E.C.*, 1939-40 *Rep.* p. 266 (1942).

Crataegus orientalis Bieb. Mr. *J. P. M. Brenan* points out that this is the correct name for the tree on Shapwick Moor, S., which was recorded as *C. Azarolus* L. in "Bristol Botany in 1920 and 1921." The tree was still there in September, 1942.

Erigeron strigosus Muhl. Several plants of this North American species occurred in a marsh in the sand-dunes near Berrow, S., July, 1940, *J. P. M. Brenan* and *Rev. N. E. G. Cruttwell*.

Hieracium brunneo-croceum Pugsl. Field behind Iron Acton Church, G., *Ivor Evans*.

Limonium Suworowii (Regel) O. Ktze. Tip at Ashton, Bristol, S., *Ivor Evans*.

Acanthus spinosissimus Pers. "On a ballast heap outside Bristol," comm. Keeper of Dept. of Botany, Nat. Museum of Wales. Identified at Kew. This is new to the British list, and both this and the preceding species are first records for the Bristol adventive flora.

Calystegia sylvestris (Willd.) R. et S. Along a hedge on the S.E. side of the moat of the Bishop's Palace, Wells, S., *Dr. J. N. Mills* and *J. P. M. Brenan*.

Fagopyrum tataricum (L.) Gaertn. Garden-weed at Field Farm, Shepton Mallet, S., probably introduced with bird-seed, *J. P. M. Brenan*.

Rumex pulcher L. ssp. *divaricatus* (L.) Murb. Wapping Wharf, Bristol, G., *C. Sandwith* and *J. P. M. Brenan*. Confirmed by Mr. *J. E. Lousley*.

R. scutatus L. On an old wall, Clifton, G., *Mrs. Bell*. New to the Bristol list.

Digitaria sanguinalis (L.) Scop. Alma Road, Clifton, G., in a crack between a wall and the pavement, *C. and N. Sandwith*. Also at Wapping Wharf, G.

Eragrostis pilosa (L.) Beauv. and *E. cilianensis* (All.) Lutati both occurred in the autumn at Wapping Wharf, G., C.I.S., det. C. E. Hubbard.

HEPATICS. *Leptoscyphus anomalus* (Hook.) Mitt. was found by the writer on the peat moor near Meare, S., in August, 1941, and was a first record for the county of Somerset; while in the same locality, in September, 1942, she found *Lophozia Floerkii* (Web. et Mohr) Schiffn., which was new to North Somerset (v.c. 6).

FUNGI. *Puccinia caulicola* Schneid. was discovered by N. Y. Sandwith in September, growing on stems of Marjoram (*Origanum vulgare*) in a lane on the Cadbury Ridge above Tickenham, S. Previously (in 1941) he had noted this rust growing in increasing plenty on the same host on the North Downs in Surrey (as at Mickleham and East Horsley) and on the Chilterns at Fingest, Bucks. The fungus was identified by Miss E. M. Wakefield of Kew, who reported that it has very rarely been collected in this country, and then always on *Thymus* (its typical host), never on *Origanum*; while Dr. Malcolm Wilson, who confirmed the identification, wrote that it is possible that the Marjoram rust should be separated as a distinct species. The dark chocolate-brown teleutospores appear in conspicuous patches from fissures up the stems, and the Marjoram host is usually stunted, with numerous branches, very reduced leaves and poor inflorescences.

Mr. F. W. Evens has added 23 slides to his fine collection of seeds, with descriptions and notes on the dispersal of fruits and seeds by animals. His recent collecting includes 2 *Hypericum* spp., 3 *Linaria* spp. and 8 species of *Compositae*.

Sergt.-Observer Reginald Frederick Miles, killed in action in May, was a member of the Bristol Naturalists' Society before going as a student to the Royal Botanic Gardens, Kew. He showed great ability and was a keen naturalist. His loss at an early age is to be deeply regretted.

Ornithological Notes, Bristol District, 1942

By H. H. DAVIS, M.B.O.U.

(Received, Jan. 16, 1943)

OWING to lack of available time and the general curtailment of travelling facilities, few observers have been able to go far afield in 1942. Early in the year, however, occasional visits were made to the North Somerset reservoirs, and among interesting occurrences noted were four Bewick's Swans at Blagdon for the second successive January, Gadwall at the same place in January and April, and a Long-tailed Duck at Cheddar in March and May, while a Velvet-Scoter identified at Barrow Gurney late in March was still there during the second week of April. In the autumn, single visits were made to Barrow Gurney and Blagdon but with no spectacular results. It is a matter of regret that regular observations at these reservoirs could not be carried out at what is usually so productive a season.

Uncommon visitors to the Severn Estuary include a Short-eared Owl, a Merlin and an Arctic Skua—all noted in October, while a Ruddy Sheld-Duck seen on several dates in April and again in June must be regarded as a probable escape from captivity. A quite interesting record was established when a pair of Herring-Gulls was found nesting at Aust Cliff in June. From the Avon, at Sea Mills, there are reports of a Black Redstart in November, a Ruff in February and a Scandinavian Lesser Black-backed Gull in October.

Among noteworthy records from other parts of the area, special mention may be made of a Pied Flycatcher at Rudgeway in April, a probable Hoopoe at Weston-in-Gordano in June, a Short-eared Owl at Abbots Leigh in September, a Hobby near Stoke Gifford in August, and Buzzards at Bentry and Little Stoke on several occasions from May to September. Quail were located at Patchway in June and at Elberton in December—the latter occurrence providing a unique record for the district.

Specific notes given below represent the more important observations by the following members of the B.N.S. Ornithological Section—R. Alley, A. E. Billett, Rev. F. L. Blathwayt, H. H. Davis, R. P. Gait,

B. King, A. C. Leach, G. Mogg, H. W. Neal, D. M. Skinner, R. A. Skinner and H. Tetley.

RAVEN (*Corvus c. corax*). On February 14 the Avon Gorge birds were watched round a previous nesting site immediately over the municipal tennis courts. Although frequently looked for afterwards they were not seen again.

STARLING (*Sturnus v. vulgaris*). Throughout January and February enormous numbers continued to roost at High Wood. On March 8 huge flocks were still coming in, but on the 11th it became apparent that the birds were moving elsewhere, and a visit to the roost on the 15th showed that it had been almost entirely forsaken. On subsequent evenings flocks were noted flying east from their old quarters, but these formed a very small part of the original numbers and it was soon evident that the majority of the birds had moved out of the district. As winter immigrants from abroad are known to leave the British Isles at this time, it seems safe to assume that the bulk of the High Wood Starlings were of continental origin.

SISKIN (*Carduelis spinus*). Several were seen along the River Chew at Woollard on March 20.

LESSER REDPOLL (*Carduelis f. cabaret*). Three were feeding in Birches in the Rectory garden at Dyrham on October 1 and again on November 3. Twelve birds in the same place on November 2 were almost certainly Redpolls.

BRAMBLING (*Fringilla montifringilla*). Five or six, in company with many Greenfinches and Chaffinches, were frequenting a stack-yard at Little Stoke throughout the greater part of February.

CIRL BUNTING (*Emberiza c. cirrus*). Seen as follows—a pair at Sea Mills on March 28, a male at Portishead on June 5 and a pair in Falcondale Road, Westbury-on-Trym, on July 18.

TREE-SPARROW (*Passer m. montanus*). A few were observed at Dyrham on various dates from January to late March. Thirty, or more, were noted in the same locality in the last week of August, and smaller numbers were frequently met with from September to mid-December.

SPOTTED FLYCATCHER (*Muscicapa s. striata*). A pair at Little Stoke reared two broods from the same nest. The first left the nest on June 26 and the second on, or about, August 5.

PIED FLYCATCHER (*Muscicapa h. hypoleuca*). One spring record—a male at Rudgeway on April 25.

CHIFFCHAFF (*Phylloscopus c. collybita*). A late egg-date is reported from Almondsbury where a nest with clutch of four was found on July 20.

WOOD-WARBLER (*Phylloscopus sibilatrix*). One was seen and heard at Dyrham on April 16—an early date.

GRASSHOPPER-WARBLER (*Locustella n. naevia*). On May 1 one was frequenting a rough hedgerow adjoining the Court Farm Building Estate, Stoke Gifford. It was heard, or seen, in the same spot on various dates until the 19th, but not afterwards. At no time was there any evidence of a second bird being present. The only previous record for this part of the district is that of a pair found nesting at Over, Almondsbury, in May 1935.

SEDGE-WARBLER (*Acrocephalus schænobænus*). One was seen and heard at Barrow Gurney as early as April 12.

BLACK REDSTART (*Phoenicurus o. gibraltariensis*). One, apparently an adult male, was disturbed from a cabbage patch at Sea Mills on November 1.

DIPPER (*Cinclus c. gularis*). Reported from three localities on the Gloucestershire side of the City—one on a stream at Dyrham on February 4, one on the River Frome at Stapleton on March 10 and two on the Little Avon River between Stone and Tortworth on May 17 and July 19.

NIGHTJAR (*Caprimulgus e. europæus*). One was seen in an orchard at Sea Mills on the evening of September 4.

HOOPOE (*Upupa e. epops*). Although the evidence is not entirely conclusive, it appears fairly certain that one was present at Weston-in-Gordano on June 20. The bird in question was viewed at close quarters by a farm-hand who was immediately attracted by its conspicuous crest. In an unprompted description given to Mr. R. P. Gait, the man compared the bird with a Turtle-Dove, and further gave an intelligent explanation as to how its crest differed from that of a Lapwing. On being shown a sketch of a Hoopoe's head, he at once agreed that that was the species. It may be of interest to record here that in the *Stroud News and Gloucester County Advertiser* for June 19, 1942, a Hoopoe was reported as having been seen by a competent

observer near Stroud. The date of the occurrence was omitted, but in correspondence with Mr. H. C. Playne, of Minchinhampton, the observer gave this as June 9.

LESSER SPOTTED WOODPECKER (*Dryobates m. comminutus*). There were good opportunities in May and June of watching a nesting pair in the Dyrham Rectory garden. As winter "drumming" is apparently not usual, it may be added that this was heard and seen in the same garden on various dates during the extremely mild weather of November and December. Single birds were seen at Little Stoke on February 1, at Portishead on June 5, and on the Northumberland House Estate, Henleaze, on August 14.

SHORT-EARED OWL (*Asio f. flammeus*). Twice reported—one at Abbots Leigh on September 20 and one below Severn Beach on October 6.

PEREGRINE FALCON (*Falco p. peregrinus*). Single birds observed near Severn Beach on March 15 and October 25, at Sea Mills on November 1, at Aust Cliff on November 2, and in the Avon Gorge on November 8 and December 10.

HOBBY (*Falco s. subbuteo*). Excellent views were obtained of one overhead between Patchway and Stoke Gifford on August 22 and again on the 24th.

MERLIN (*Falco c. aesalon*). A female, or immature bird, was clearly identified at Severn Beach on October 25.

COMMON BUZZARD (*Buteo b. buteo*). In recent years Buzzards have been noted with increasing frequency over a wide area of North Somerset, and it now appears evident that the bird is reaching the Gloucestershire side of the City. One, being mobbed by Jackdaws, was seen by the writer between Patchway and Stoke Gifford on September 6, while Mr. R. A. Skinner reports seeing one at Brentry on May 7, and two on July 19. Notes received from the latter observer show that one was watched in the Brentry locality on various occasions from July 31 to September 12, 1941.

COMMON HERON (*Ardea c. cinerea*). The Brockley Combe and Banwell Heronries were visited in May and careful counts made of breeding pairs. Sixteen nests were found to be occupied at Brockley on the 17th, and thirty-one at Banwell on the 31st—a decrease of sixteen as compared with the 1941 total.

BEWICK'S SWAN (*Cygnus b. bewickii*). In last year's issue of the *Proceedings* (p. 296) the occurrence is reported of four Bewick's Swans (two adults and two immatures) at the Ubley end of Blagdon reservoir on January 12, 1941. By a curious coincidence, a similar number (in similar proportions) were found at this identical spot on January 11, 1942. The possibility that the two observations refer to the same birds is at once apparent, but this must continue as mere speculation unless it can be shown that adults and young may remain together for more than a year and, consequently, that Bewick's Swan is not, in all cases, an annual breeder. Of the immatures, however, it may be remarked that, while the plumage of the 1941 birds was not recorded in detail, that of the 1942 young was noted as being uniformly pale greyish, with no evidence of any brownish markings. It can further be stated that the bills of the 1941 young were pinkish-brown, with no trace of yellow at the bases, whereas in those of 1942 the yellow was quite evidently in an advanced state.

SHELD-DUCK (*Tadorna tadorna*). A single bird was present at Blagdon reservoir on January 11.

RUDDY SHELD-DUCK (*Casarca ferruginea*). A male was watched by several observers on the mud-flats below Aust Ferry Pier on various occasions from April 18 to 25 and was again seen on June 2 along the river bank at Severn Beach. It was usually in company with Common Sheld-Duck, compared with which it looked slightly larger, and more goose-like both in carriage and flight. When not feeding, much of its time was spent in calling (a loud honking note) or in persistent attacks on its companions. While the possibility of its being a genuinely wild visitor cannot be entirely ruled out, it must be regarded as a highly probable escape from confinement.

GADWALL (*Anas strepera*). This scarce visitor to the reservoirs was twice met with at Blagdon—a pair on January 11 and two males and a female on April 13.

PINTAIL (*Anas a. acuta*). A male at Cheddar reservoir on January 25 is the only record for the year.

GOLDENEYE (*Bucephala c. clangula*). A few were noted at Blagdon and Cheddar on various dates from early January to mid-May, the largest number seen being twelve at Cheddar on March 22.

LONG-TAILED DUCK (*Clangula hyemalis*). One, a female or immature, was accompanying Tufted Duck at Cheddar reservoir on March 22,

and one, probably the same bird, was present as late as May 3. Five, an adult male and four females, are reported as being seen at the same place on January 28 (cf. *British Birds*, Vol. XXXV, p. 275). Previous records of this Duck in Somerset are very few.

VELVET-SCOTER (*Melanitta f. fusca*). An immature male identified at Barrow Gurney on March 29 was still there on April 12. The only previous record for the North Somerset reservoirs is that of one, also an immature male, seen at Blagdon early in 1939 (cf. *Proc.*, B.N.S., 1939, p. 30).

SMEW (*Mergus albellus*). The following, all "redheads," were seen at the reservoirs—nine at Blagdon on January 11, six at Cheddar on the 25th and one at Barrow Gurney on March 29.

BLACK-NECKED GREBE (*Podiceps n. nigricollis*). One was seen at Cheddar reservoir on March 22.

BAR-TAILED GODWIT (*Limosa l. lapponica*). The only note for the year is that of a single bird below Severn Beach on May 5.

WHIMBREL (*Numenius ph. phæopus*). Two overhead at Little Stoke on August 1 were making for the Severn.

WOODCOCK (*Scolopax r. rusticola*). One was flushed from a small copse at Tockington on March 22.

TURNSTONE (*Arenaria i. interpres*). Ten, or more, were seen below Severn Beach as late as May 31, and two were still there on June 2. Turnstones have now been noted on this stretch of mud in all months of the year.

KNOT (*Calidris c. canutus*). A single bird, still in winter plumage, was seen below Severn Beach as late as June 2.

PURPLE SANDPIPER (*Calidris m. maritima*). Frequently noted off Severn Beach from January to March—the largest number being eight on February 22.

SANDERLING (*Crocethia alba*). Twice reported in the spring—three at Cheddar reservoir on May 14 and nine at Severn Beach on the 31st.

RUFF (*Philomachus pugnax*). What proved to be a wintering Ruff was seen on the Avon mud below Sea Mills on February 23. The bird, probably a male, was still there on the 24th and was watched on both the Gloucester and Somerset sides of the river. When seen with a Redshank it appeared slightly larger, and was altogether paler and

greyer than the usual buff-coloured autumn migrants. The only previous winter record for the district is that of one identified at Blagdon reservoir in December 1937 (cf *Report on Somerset Birds*, 1937, p. 25). Several immatures visited marshy ground at Stoke Gifford early in September. Of three seen on the 3rd, two were still present on the following day and one on the 6th. There is no previous inland record for the Gloucestershire side of the City.

COMMON SANDPIPER (*Actitis hypoleucos*). Three or four frequented marshy ground at Stoke Gifford from September 2 to 4 and were sometimes to be found feeding round a flooded bomb-crater. The bird has seldom been noted in this particular locality.

GREEN SANDPIPER (*Tringa ochropus*). One was put up at No. 2 reservoir, Barrow Gurney, on September 4.

GOLDEN PLOVER (*Pluvialis apricaria*). Thirty overhead at Stoke Gifford on January 21 were flying S.W. in hard weather. A small party was seen in a field between Charlton and Patchway on March 3.

GREY PLOVER (*Squatarola squatarola*). The only record for the year is that of four on the mud below Severn Beach on October 15.

OYSTER-CATCHER (*Hæmatopus ostralegus occidentalis*). One is reported as having been seen feeding in a field at Henbury on September 12.

BLACK TERN (*Chlidonias n. niger*). Single birds were seen at Blagdon on April 29 and October 13 and at Cheddar on May 24.

BLACK-HEADED GULL (*Larus r. ridibundus*). An adult, bearing ring—Zoolog. Museum, Denmark, z 26738, was found dead at Barrow Gurney on January 8. Despite present difficulties in obtaining ringing data from the Continent, it has been ascertained that the bird was ringed, as a fledgling, at Horsens Fjord, E. Jutland, on June 21, 1939. Details of previous recoveries of ringed Black-headed Gulls in the Bristol area are—

RINGED	RECOVERED
N. Bohemia - - 24.5.1914	Horfield Common - 28.1.1915
Texel - - - 31.5.1930	St. Philip's Marsh - 15.3.1934
Bautzen, Saxony - 4.6.1931	Blagdon - - - 5.1.1935

COMMON GULL (*Larus c. canus*). Particularly abundant on the Avon at Sea Mills in late February—at least 250 being present on the 24th.

HERRING-GULL (*Larus a. argentatus*). The nesting of a pair at the foot of Aust Cliff provides the first breeding record for this, or any other, Gull for the county of Gloucestershire. The nest, first located on June 5, contained two eggs on the 7th and remains of a third were lying nearby. The site was revisited on the 8th and photographs obtained. Although still present on the 14th, the birds had quite evidently lost interest in the nest which was found to be empty. With the frequent passing of pedestrians, it seems likely that the eggs were taken.

SCANDINAVIAN LESSER BLACK-BACKED GULL (*Larus f. fuscus*). A Lesser Black-back watched in a good light at Sea Mills on October 22 was, from its uniformly black mantle and primary tips and its corresponding size to the British race, clearly referable to this northern form.

ARCTIC SKUA (*Stercorarius parasiticus*). Close views were obtained of one, a dark bird, off Severn Beach on October 15.

CORN-CRAKE (*Crex crex*). Twice met with on return passage—one in a wheat field at Stoke Gifford on August 29 and one in a barley crop above Dyrham Wood on September 11.

RED-LEGGED PARTRIDGE (*Alectoris r. rufa*). The "chik-chik-chikar" call was heard, and a bird seen, at Little Stoke on March 30.

QUAIL (*Coturnix c. coturnix*). On June 14 the characteristic "whit-whi-whit" call (emphasis on first and last syllables) was heard, apparently from two birds, in fields between Patchway Common and Savage's Wood. One calling in the same place on the 15th was stalked and finally flushed from long mowing grass. There was no subsequent evidence to show that a pair remained to breed. An extraordinary occurrence is that of a bevy of seven, reported as seen by two observers, at Elberton on December 28. The birds, described as being like small sandy-brown Partridges with similar flight, were disturbed at close quarters from the outskirts of a recently planted cornfield, and on alighting some seventy yards out were at once, despite the lack of cover, quite impossible to see. When approached later from two directions simultaneously, they again got up and, flying low, disappeared over an adjoining hedgerow. The failure of these birds to migrate may perhaps be attributed to the abnormally mild weather from September onwards.

Species of *Archoceras* from Saltern Cove, Devon

By DESMOND T. DONOVAN, B.Sc., F.G.S.

(Received, Dec. 11, 1942)

DURING a recent excursion to the Torquay district, a visit was made to the Upper Devonian Beds of Saltern Cove, near Paignton. Fossils were collected from the locality at the north end of the Cove (Waterside Cove) which yields a goniatite fauna resembling that of the Budesheimer Schiefer in Germany. The goniatites obtained were kindly identified by Dr. L. F. Spath who reported that two of the specimens probably belonged to a new species of *Archoceras*. With a view to obtaining further material, the locality was re-visited and several more specimens were collected. Finally, Mr. L. G. Anniss kindly lent the specimens obtained by him during the preparation of his paper on the geology of the Cove (Annis, 1927, p. 492).

I should like to express my thanks to Dr. L. F. Spath for pointing out the probable position of the new species, and to Prof. W. F. Whittard for his supervision and help throughout the work. To both the above gentlemen I am indebted for reading and criticising the manuscript. Mr. E. W. Seavill is responsible for the photographs. My parents have helped me in the translation of literature from the German, and my father has also assisted me in the field.

Family **ANARCESTIDÆ** Steinmann em. Wedekind 1918

Archoceras Schindewolf 1938

The genus *Archoceras* was established by Schindewolf (1938, p. 243, fig. 12, pl. xix) to receive *A. paeckelmanni*, which occurs in the Upper Devonian, Horizon IIa (the Nehdener Schiefer), of Germany and French Morocco. He also transferred to the new genus, with a query, the species first described by Drevermann (1901, p. 140, pl. xiv, figs. 10 and 10a) as a gastropod, *Euomphalus varicosus*, and by Wedekind (1913, p. 69, pl. vi, fig. 6) as a goniatite, *Gephyroceras bickense*. Gallwitz (1938, pp. 377-381, figs. 1-3) confirmed the position of the latter in *Archoceras*, but found that under this specific name two distinct species had been included. He therefore revised the nomenclature, gave a fresh description of *A. varicosum* (Drevermann) and created a new

species, *A. schlosseri* Gallwitz. These forms occur in Horizons I (β) γ and I δ of the German Upper Devonian, and are both characterised by the possession of four to five ridges (corresponding to constrictions) per whorl, these being more strongly marked than the growth-lines. They differ in the proportions of the whorls, and in the fact that *A. schlosseri* becomes more involute than the other species.

Gallwitz mentions a fourth type (1938, p. 381), represented by a solitary specimen from Horizon I δ , which is near *A. paeckelmanni* but is distinguished from it by the course of the growth-lines, which are also more strongly marked than in the other species.

Archoceras is regarded by Schindewolf (1938, p. 251) as representing the primitive stock from which the Manticoceratidæ, and possibly the Sub-Order Clymenacea, were derived. With *Werneroceras* from Horizon II α (Schindewolf, 1933, p. 88), it is an Upper Devonian survival of the Anarcestidæ. The only other known member of this Family from the Upper Devonian which has such a simple suture-line is *Raymondiceras* (Schindewolf, *non* Spath), which is peculiar to North America (Schindewolf, 1934, pp. 336-340, and Miller, 1938, pp. 171-174, pl. xxxviii, figs. 1-6).

In a member of the Cheiloceratidæ, *Cheiloceras* sp. nov. (Schindewolf, 1929, p. 32, fig. 14), the earliest stage in the development of the suture-line is similar to the adult suture-line of *Archoceras*, and is composed of the same simple elements, which differ slightly from *Archoceras* in their proportions.

Higher in the Upper Devonian, species of the Sub-Order Clymenacea are found with suture-lines of the same type; *Progonioclymenia acuticosta* (Braun) is an example (Schindewolf, 1937, p. 56, fig. 6). In this group, however, even simpler suture-lines are also found.

The simplest suture-lines present in the Manticoceratidæ differ from that of *Archoceras* only in possessing a small median saddle. In the young stages of such forms this is absent. The Manticoceratidæ, however, occur already in Horizon I α of the Upper Devonian, so there can be no direct relationship with any species of *Archoceras* at present known, the first record of which is from the I (β) γ Horizon.

The above facts show that the primitive *Archoceras* type of suture-line can be matched in at least three other groups of Upper Devonian goniatites. The fact that it is a simple type, however, suggests the possibility that it was produced independently in more than one line of development. The presence of suture-lines similar to that of

Archoceras in other groups, therefore, does not necessarily indicate direct genetic relationship.

Archoceras angulatum, sp. nov.

(Plate 13, figs. 1-6.)

1927. *Manticoceras bickense*, pars, Annis, p. 496.

1933. *Manticoceras bickense*, pars, Ussher & Lloyd, p. 88.

The species is a dwarf form, the largest specimen known being less than 10mm. in diameter, and resembles the other species of the genus in this respect and in being very evolute. The umbilicus occupies, on an average, 60 per cent. of the total diameter, but may occupy a little more or less. The whorls are depressed, the height in adult whorls being only 58 per cent. of the thickness. The sides of the whorls are rounded; the venter is flat in the holotype, but is slightly curved in some of the other specimens. The inner whorls are coronate (pl. 13, fig. 5); this shape is gradually replaced by that shown in fig. 4, the transition being complete at a diameter of about 6.0 mm. The whorls increase in size slowly, and each is about one and a half times the height of that preceding.

The specimens are represented by internal casts in limonite. Any markings which may have occurred on the test are therefore not normally preserved. The holotype shows growth-lines on part of the last whorl, which are hardly visible on the side of the whorl, curve sharply forwards over the angle between the sides and the venter, and then curve back to form a hyponomic sinus. They cannot be traced as far as the mid-line.

The length of the body-chamber is at least three-quarters of a whorl, possibly more.

The suture-line is of typical *Archoceras* pattern and is composed of three lobes and two saddles, all simple and undivided. The external lobe is bell-shaped. The lateral lobe is half the depth of the external lobe, whereas in the other species it is only one-quarter of the depth. A second distinguishing feature is that the umbilical suture cuts the suture-line in the centre of the lateral saddle, instead of between the lateral lobe and saddle as in the other species (pl. 13, figs. 6, 7). The suture-lines are at first widely spaced: there are four in the third whorl, but in later whorls they become much more frequent.

The protoconch is represented in two specimens, and is about 0.2 mm. in the greatest diameter.

Dimensions of Holotype. The diameter is 8.2 mm.; the breadth of the last whorl is 3.1 mm., and the height 1.8 mm. The umbilicus is 58.5 per cent. of the diameter.

Geological Horizon and Locality. All the specimens were collected from the Upper Devonian mudstones, at the southern end of Waterside Cove; for the exact locality see Anniss (1927, p. 492 and 498) and Ussher and Lloyd (1933, p. 87). The faunal assemblage indicates the Iy Horizon of the Manticoceras Stage of the Upper Devonian.

Holotype. G.S.M.: 63381.

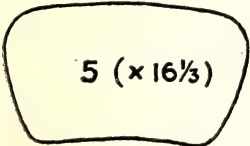
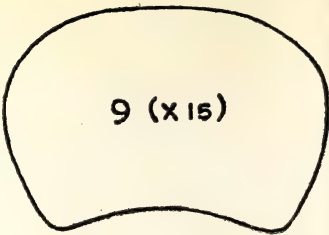
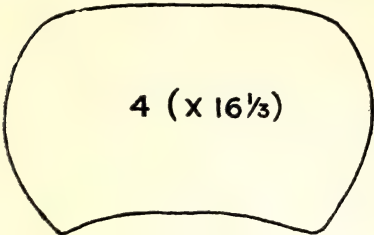
Paratypes. B.M.: C.40153 and G.S.M.: 63382.

Remarks. The species here described is distinguished from the others in the genus by the flattened venter and the depth of the lateral lobe of the suture-line. The earliest whorls of *A. varicosum* show a flattened venter, but after about the fourth whorl this becomes rounded. The close approximation of the adult whorl-section of *A. angulatum* to that of the young stages of other species may indicate that it is more primitive. The growth-lines of *A. angulatum* resemble those of the single specimen of *Archoceras* to which Gallwitz did not give a specific name (1938, p. 381). The latter specimen possesses constrictions running at intervals parallel to the growth-lines, but from Gallwitz's description (he gives no figure) it is otherwise similar to the present species. It is regarded by Gallwitz as an ancestor of *A. paeckelmanni*. *A. angulatum* could certainly have given rise to *A. paeckelmanni*, which it resembles more closely than do either of its contemporaries, *A. varicosum* or *A. schlosseri*.

Archoceras varicosum (Drevermann)

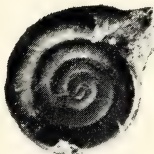
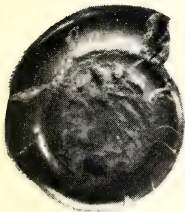
(Pl. 13, figs. 8, 9)

- 1901. *Euomphalus varicosus*, Drevermann, p. 140, pl. xiv, figs. 10, 10a.
- 1913. *Gephyroceras bickense*, Wedekind, p. 69, pl. vi, fig. 6.
- 1918. *Manticoceras bickense* (Wedekind), Wedekind, p. 124, pl. xxii, fig. 6.
- 1922. *Manticoceras bickense* (Wedekind), Paeckelmann, p. 117.
- 1927. *Gephyroceras sandbergeri* Schlosser, p. 8, fig. 5.
- 1927. *Manticoceras bickense* (Wedekind) *pars*, Anniss, p. 496.
- 1933. *Manticoceras bickense* (Wedekind) *pars*, Ussher and Lloyd, p. 88.
- 1938. *Archoceras* (?) *varicosum* (Drevermann) *pars*, Schindewolf, p. 249-250, fig. 2, pl. xix, fig. 5.
- 1938. *Archoceras varicosum* (Drevermann) Gallwitz, p. 377, fig. 1.



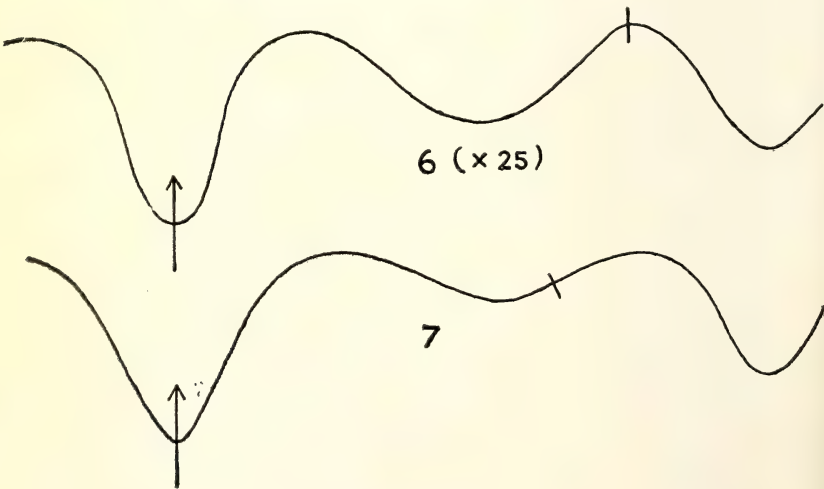
8 (x 4)

2 (x 4)



1 (x 4)

3 (x 7)



ARCHOCERAS

The material in the collections of Mr. Anniss and myself does not show any details which are not recorded in the most recent description published by Gallwitz (1938). The specimens are preserved as internal casts, the largest being 10 mm. in diameter. The ridges are not clearly preserved, but only the constrictions which accompany them. The interest attached to the fossil is that it is the first record of this species of *Archoceras* from the British Devonian rocks.

Geological Horizon and Locality. The species occurs in the Iy Horizon of the Manticoceras Stage, Upper Devonian, as developed at Waterside Cove, near Paignton.

EXPLANATION OF PLATE 13

(All specimens except fig. 7 are from the Manticoceras Stage, Upper Devonian, of Waterside Cove.)

Archoceras angulatum sp. nov.

- Fig. 1. Side view of internal cast showing form of the whorl, the suture-line, and the body-chamber. Paratype, B.M. : C.40153, Whittard Coll. x 4.
- Fig. 2. Peripheral view of same specimen showing the course of the suture-line across the venter and the shape in cross-section of the last whorl. x 4.
- Fig. 3. Internal cast in which the angularity of the whorl and the protoconch are well shown. Paratype, G.S.M. : 63382, Anniss Coll. x 7.
- Fig. 4. Whorl section at a diameter of 8.0 mm. Holotype, G.S.M. : 63381, Donovan Coll. x $16\frac{1}{3}$.
- Fig. 5. Whorl section of the same specimen at a diameter of 4.8 mm. x $16\frac{1}{3}$.
- Fig. 6. Suture-line of the same specimen at a diameter of 6.6 mm. x 25.

Archoceras paeckelmanni Schindewolf

- Fig. 7. Suture-line, after Schindewolf (magnification unstated).

Archoceras varicosum (Drevermann)

- Fig. 8. Internal cast in which the rounded shape of the whorls, the constrictions on the later formed whorls, and the protoconch are visible. G.S.M. : 63383, Anniss Coll. x 4.
- Fig. 9. Whorl section at a diameter of 9.5 mm. G.S.M. : 63384, Donovan Coll. x 15.

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Additions to Bristol Insect Fauna (Diptera) since 1939

(See *Proceedings*, Vol. IX, Part I, 1939, p. 40-43)

By H. L. F. AUDCENT, M.Sc.

(Received, Jan. 14, 1943)

CECIDOMYIDAE.

Campylomyza atra Mg. S. Clevedon (A.) 21/9/40.

MYCETOPHILIDAE.

Boletina dispecta Dz. S. Leigh Woods (F. W. Edwards) 9/36.
Ent. Mo. Mag. March 1941.

Boletina nitida Grz. S. Leigh Woods (F. W. Edwards) 9/36.
Ent. Mo. Mag. March 1941.

Boletina sylvatica Dz. G. Symond's Yat (F. W. Edwards) 9/36.
Ent. Mo. Mag. March 1941.

Exechia contaminata Winn. S. Clevedon (A.) 23/9/41.

Isonneuromyia (S.G. *Neoplatyura*) *nigricauda* Strobl. S. Shepton
Mallet (A.) 29/6/42.

Leia strobli Landr. G. Tormarton (A.) 20/5/26. *Ent. Mo. Mag.*
March 1941.

Megophthalmidia crassicornis Curt. S. Clevedon (A.) 20/6/40.

Mycetophila vittipes Zett. S. Clevedon (A.) 1/5/42.

Phronia forcipula Winn. S. Clevedon (A.) 6/5/41.

Rhymosia dziedzickii Edw. G. Symond's Yat (F. W. Edwards)
9/36. *Ent. Mo. Mag.* April 1941.

SCATOPSIDAE.

Scatopse geniculata Zett. S. Clevedon (A.) 12/9/40.

CERATOPOGONIDAE.

Culicoides chiopterus Mg. S. Clevedon (A.) 20/10/39.

TIPULIDAE (LIMONIINAE).

Oxydiscus (*Adelphomyia*) *senilis* Hal. S. Clevedon (A.) 19/10/40.

Dicranomyia sera Wlk. S. Clevedon (A.) 16/9/41 ; Berrow (A.)
13/7/40.

Pilaria (*Limnophila*) *scutellata* Staeg. (*subtineta* Zett.) S.
Bleaden (A.) 20/9/41.

ANISOPODIDAE (RHYPHIDAE, PHRYNEIDAE).

Mycetobia pallipes Mg. S. Clevedon (A.) 15/7/42.

TABANIDAE.

Tabanus bovinus L. S. Clevedon (J. F. Bird) 22/6/42. N.B.—The records given in Pt. 3 (1930) p. 199 are doubtful.

ASILIDAE.

Leptogaster guttiventris Zett. S. Clevedon (A.) 4/7/41.

Neoitamus cyanurus Lw. S. Clevedon (A.) 18/6/40.

EMPIDIDAE.

Rhamphomyia gibba Fall. S. Clevedon (A.) 17/7/41.

Tachydromia exilis Mg. S. Clevedon (A.) 5/7/40.

DOLICHOPODIDAE.

Dolichopus claviger Stan. S. Clevedon (A.) 21/6/40.

Dolichopus urbanus Mg. S. Tickenham (A.) 14/6/40.

Dolichopus wahlbergi Zett. S. Clevedon (A.) 20/6/40.

Medetera petrophila Kow. S. Shepton Mallet (A.) 25/6/42.

Campsicnemus armatus Zett. S. Clevedon (A.) 16/9/41.

PLATYPEZIDAE.

Agathomyia antennata Zett. S. Clevedon (A.) 21/8/40.

Platypeza (Clythia) dorsalis Mg. S. Clevedon (A.) 29/7/40.

CONOPIDAE.

Leopoldius signatus Wied. S. Clevedon (A.) 27/9/42.

TACHINIDAE.

Aplomyia (Exorista) confinis Fall. S. Clevedon (A.) 29/7/40.

Blondelia (Lydella) nigripes Fall. A. Clevedon (A.) 17/7/41 ;

G. Rodborough (T. Bainbrigge-Fletcher) 2/6/36.

Carcelia gnava Mg. S. Clevedon (A.) 26/8/40.

Erigone (Ernestia) consobrina Mg. S. Clevedon (A.) 30/7/40.

Eumea (Exorista) westermanni Zett. S. Clevedon (A.) 1/5/42.

Euryclaea (Pematomyia) phalaenaria Rond. S. Clevedon (A.) 28/5/40.

Meigenia bisignata Mg. S. Clevedon (A.) 19/5/42.

Pseudoperichaeta insidiosa R.D. (*Zenillia roseanae* B.B.). S. Clevedon (A.) 23/7/40.

Sarcophaga (S.G. Villeneuveella) agnata Rond. S. Keynsham (A.) 24/5/36.

Sarcophaga (S.G. Bellieria) ebrachiata Pand. S. Shepton Mallet (A.) 29/6/42.

Sarcophaga (S.G. *Thyrsocnema*) *hirticrus* Pand. S. Clevedon (A.) 30/7/40.

Sarcophaga (S.G. *Kramerella*) *setipennis* Rond. S. Clevedon (A.) 13/6/41.

Sarcophaga (S.G. *Sarcotachinella*) *sinuata* Mg. S. Clevedon (A.) 12/9/40.

Sarcophaga (S.G. *Ravinia*) *striata* Fab. S. Clevedon (A.) 1/9/40.

Sarcophaga (S.G. *Bellieria*) *subulata* Pand. (*laciniata* Pand.). S. Clevedon (A.) 2/7/41.

Sarcophaga (S.G. *Athyrsia*) *villeneuvei* Böttch. S. Clevedon (A.) 26/8/40.

Pollenia excarinata Wwt. S. Tickenham (A.) 2/10/41.

MUSCIDAE.

Chortophila (S.G. *Pogonomyza*) *cinerosa* Zett. S. Clevedon (H. W. Andrews) 19/7/42.

Chortophila (S.G. *Tricharia*) *trichodactyla* Rond. S. Shepton Mallet (A.) 25/6/42.

Coenosia nigridigita Rond. S. Clevedon (A.) 27/5/40.

Fannia polychaeta Stein. S. Clevedon (A.) 17/7/41.

Hydrotaea similis Mde. S. Clevedon (A.) 18/6/40.

Lispa nana Macq. S. Clevedon (A.) 17/8/40.

Pegomyia squamifera Stein. S. Clevedon (A.) 18/10/40.

SCATOPHAGIDAE (CORDYLURIDAE).

Megophthalmum pallidum Fall. S. Clevedon (A.) 27/8/40.

Scoliocentra villosa Mg. S. Clevedon (A.) 25/3/42.

Thelida rotundicornis Zett. S. Clevedon (A.) 13/2/41.

TRYPETIDAE.

Acidia cognata Wied. G. Rodborough (T. Bainbrigge-Fletcher) 22/9/33 and 7/9/35.

Orellia (Trypeta) falcata Scop. G. Symonds Yat (T. Bainbrigge-Fletcher) 19/5/42; Rodborough, Stroud (T. Bainbrigge-Fletcher) 9/6/42.

Phagocarpus permundus Harr. S. Clevedon (A.) 5/8/40.

Trypeta (Spilographa) artemisiae Fab. S. Clevedon (A.) 23/8/40.

LAUXANIIDAE (SAPROMYZIDAE).

Lauxania geniculata Fab. S. Clevedon (A.) 18/6/40.

PSILIDAE.

Chamaepsila (Psila) rufa Mg. G. Almondsbury (R. Bassindale) 20/5/42.

SEPSIDAE.

Themira minor Hal. S. Tickenham (A.) 14/6/40.

TETANOCERIDAE (SCIOMYZIDAE).

Sciomyza annulipes Zett. S. Clevedon (A.) 18/6/40.

Sciomyza scutellaris v. Ros. S. Shepton Mallet (A.) 6/7/42.

Tetanocera nigricosta Rond. S. Clevedon (A.) 16/6/41.

COELOPIDAE.

Coelopa frigida Fall. S. Clevedon (A.) 15/3/41.

DROSOPHILIDAE.

Scaptomyza incana Mg. S. Leigh Woods (A.) 12/10/22; Clevedon (A.) 16/9/41; G. Blaise Castle Woods, Bristol (A.) 11/4/27.

ASTEIIDAE.

Leiomyza laevigata Mg. S. Clevedon (A.), 5/9/41.

EPHYDRIDAE.

Discomyza incurva Fall. S. Tickenham (B. N. Blood) 7/9/41.

Hydrellia erythrostoma Mg. (*nigripes* Zett.). S. Clevedon (A.) 18/6/41.

Hydrellia thoracica Hal. S. Clevedon (A.) 12/8/40.

Napaea (Parhydra) fossarum Hal. S. Clevedon (A.) 4/6/40.

Scatella (Lamproscatella) sibilans Hal. S. Clevedon (A.) 18/6/41.

Scatophila noctula Mg. (*laevigata* Lw.). S. Tickenham (A.) 2/10/41.

CYPSELIDAE (BORBORIDAE).

Leptocera (Limosina) fulviceps Rond. S. Tickenham (A.) 30/8/40.

CHLOROPIDAE.

Dicraeus pallidiventrís Macq. S. Clevedon (A.) 16/9/41.

Meromyza decora Frey. S. Clevedon (A.) 8/7/40.

Oscinosoma (Oscinis) cognatum Mg. S. Clevedon (A.) 18/6/40.

Oscinosoma maurum Fall. (*albiseta* Mg.). S. Clevedon (A.) 11/6/40.

AGROMYZIDAE.

Cerodonta fulvipes Mg. (*spinicornis* Macq.). S. Tickenham (A.) 2/10/41.

Cerodonta nigritarsis Mg. (*nigroscutellata* Strohl.). S. Berrow (A.) 18/9/41.

Liriomyza fasciola Mg. (*bellidis* Meij.). S. Clevedon (A.) 14/9/40.

Phytomyza perichlymeni Meij. S. Clevedon (A.) 12/6/40.

CORRECTIONS

1. For *Sympycnus annulipes* Mg. (*Proc. Bris. Nat. Soc.*, 7, 206, 1930) substitute *Sympycnus desoutteri* Par. (*annulipes* auct. nec Mg.).
2. *Scatophaga decipiens* Hal. (*Proc. Bris. Nat. Soc.*, 7, 433, 1933) delete records for Olveston, Ham Green and Sharpam.
3. *Dicranomyia sera* Wlk. (*Proc. Bris. Nat. Soc.*, 7, 123, 1929) delete record for Blaise Castle Woods.
4. For *Mycetophila vittipes* Zett (*Proc. Bris. Nat. Soc.*, 7, 127, 1929) substitute *Mycetophila gibbula* Edw.
5. For *Culicoides varius* Winn. (*Proc. Bris. Nat. Soc.*, 7, 50, 1928) substitute *Culicoides obsoletus* Mg.
6. For *Bavaria jucunda* Mg. (*Proc. Bris. Nat. Soc.*, 7, 359, 1932) substitute *Cyzenis albicans* Fall.

SOME RECENT LITERATURE

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Studies on the Biology of the Bristol Channel

XIII*

THE INTERTIDAL FAUNA OF PORLOCK BAY

By R. BASSINDALE, M.Sc.

(Received, March 4, 1943)

ALL known records of the invertebrate intertidal fauna of the southern shores of the Bristol Channel and Severn Estuary have already been given in the form of a fauna list (Bassindale, 1940). The list includes records made during a recent survey of the area, but in March, 1940, a collecting expedition to Porlock Weir extended the survey and provided the material which forms the subject of the present paper. Most of the identifications are by the author but assistance has been given in the case of the Porifera, the Polychaeta and some Mollusca by Dr. M. Burton, Mr. D. P. Wilson and Mr. R. Winckworth respectively. My thanks are due to these workers and also to Professor C. M. Yonge under whose general supervision the biology of the Bristol Channel is being investigated by the Zoology Department of Bristol University. The expenses of the survey were borne by the Leverhulme Trustees and the expenses of publication have been defrayed by the Colston Research Fund.

Porlock Weir is the fifteenth collecting station to be visited during the present survey (see Bassindale, 1942A, for a chart and a brief description of other stations) and hand collections were made during equinoctial spring tides from 23 to 26 March, 1940. From salinity samples taken at high and low water on each of the four days it is apparent that little change occurs as the tide ebbs and flows, and the extreme values of 30.3 and 34.5 parts per thousand are probably only rarely exceeded during the year (see Fig. 1B, Bassindale, 1942B). Turbidity is low and the mean value for several samples at both high and low water was 0.1 parts of suspended matter per litre.

* Nos. XI and XII appear under the titles "The Physical Environment and Intertidal Fauna of the Southern Shores of the Bristol Channel and Severn Estuary" (*Journ. Ecol.* 31, 1, pp. 1-29, 1943) and "A Comparison of the Varying Salinity Conditions in the Tees and Severn Estuaries" (*Journ. Anim. Ecol.*, 1943) respectively.

Porlock Bay faces north (Fig. 8) and is flanked on the west by a shingle reef at Gore Point and on the east by the prominent headland of Hurtstone (or Hurlstone) Point which is continued as high cliffs to Minehead. Inland of the Bay is a flat valley which is protected from the invasion of the tide by a well developed shingle rampart of notable symmetry. West of Gore Point the high-water rampart gives way to cliffs which become extremely high and extend with few breaks to Ilfracombe. Near Gore Point there is a small dock, and sluicing is carried out to keep the channel clear.

The shore of Porlock Bay is composed of shingle, stones and boulders of varying sizes. The larger stones and boulders make a good collecting ground but are either too small to anchor large growths of brown algae or are scrubbed by the shingle during storms so that good growths of weeds are not a marked feature of the shore and much scrubbing of the upper surfaces of boulders is evident. The under surfaces of large stones do, however, provide attachment for numerous small animals, notably Polyzoa and tubicolous polychaetes.

Very little native rock protrudes through the boulders and shingle but some exposures are present in the middle and at the west end of the Bay (where there is also a little sand). West of Gore Point the First Rocks provided a useful collecting ground including some rock pools. Hand collecting was carried out on March 23 and 25 at First Rocks (A), on March 24 at Gore Point (B and C) and on March 26 over a wide area of Porlock Bay (PONFG).

THE FAUNA LIST

All specimens were taken by hand collecting on 23, 24, 25, and 26 March, 1940. The names of species and the authorities used in their identification are those given in the *Plymouth Marine Fauna* (1931) except where otherwise stated.

L.W.M. = Low-water mark. H.W.M. = High-water mark. M.T.L. = Mid-tide level.

An asterisk (*) denotes that the species has not been previously recorded from the southern shores of the Estuary and Channel.

A dash (—) indicates that the species has been recorded further up the Estuary.

No comment means that the species has been recorded from Lynmouth or Ilfracombe (i.e., seaward of Porlock Bay).

(Although not a notable feature of the shore, the following weeds were observed :—*Chondrus crispus* and both erect and encrusting corallines were common at First Rocks; *Fucus spiralis*, *F. vesiculosus* and

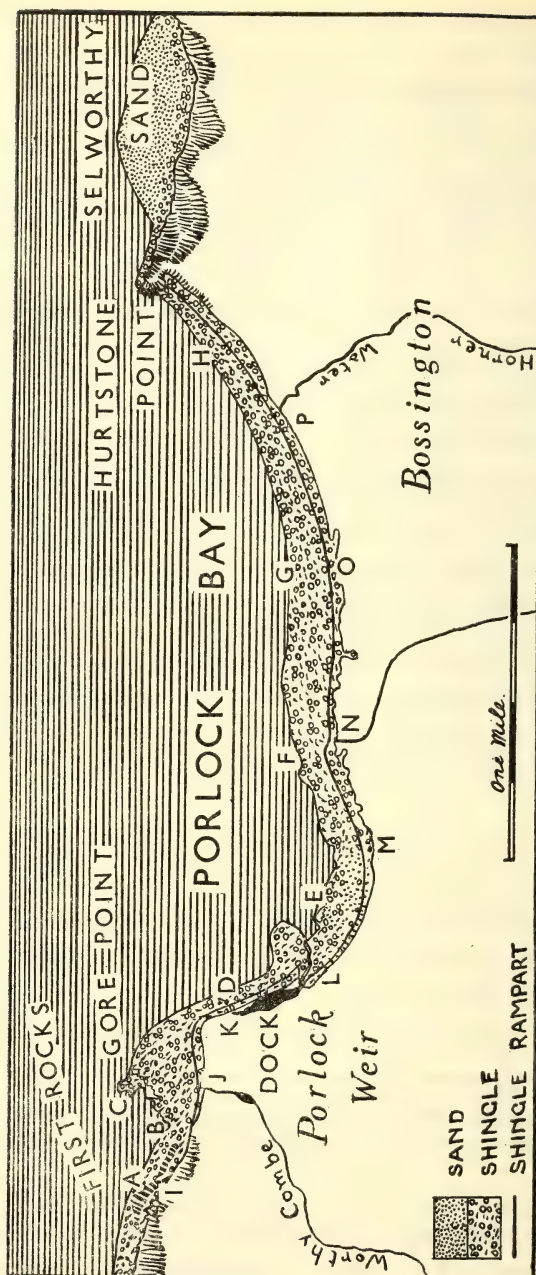


FIG. 8.—A MAP OF THE COLLECTING STATION

F. serratus were widespread, but the last two species only grew up to about 12" in length because of the scrubbing action of shingle movements; *Ascophyllum nodosum* was present at First Rocks and *Laminaria digitata* showed abundantly at L.W.M. between First Rocks and Gore Point.)

Phylum PROTOZOA

Protozoa are too small to be taken by ordinary hand collecting but several species of *Foraminifera* have been noticed on stones brought in for other purposes.

Phylum PORIFERA (Determined by M. Burton.)

DEMOSPONGIARIA. Sub-Class MONAXELLIDA

HALICHONDRIA PANICEA (Pallas). Not common except at G (Fig. 8) near a sewer outfall where it was particularly abundant.

HYMENIACIDON SANGUINEA (Grant). Small colonies near L.W.M. at First Rocks.

RASPAILA HISPIDA (Montagu). Small colony from Gore Point.

* *HALICLONA OCULATA* (Pallas). A single colony from First Rocks.

Phylum COELENTERATA

HYDROZOA

The *Hydrozoa* were conspicuous by their complete absence. The fronds and roots of *Laminaria* and various stones examined under a binocular microscope showed no signs of hydroids. It seems probable that even in summer the group is not represented.

HYDROMEDUSAE and SCYPHOZOA. Pelagic or planktonic forms were not collected.

ANTHOZOA. Sub-Class ACTINIARIA

— *ACTINIA EQUINA* L. Brown, red and strawberry varieties were widespread and common and extended down to L.W.M.

— *SAGARTIA TROGLODYTES* (Price) *Var. *DECORATA*. Two specimens at Gore point (B).

Phylum PLATYHELMINTHES

TURBELLARIA. Order Tricladida

— *PROCERODES ULVAE* (Oersted.) Common at H.W.M. in a stream at J near Gore Point; with egg capsules, 23.3.40.

Another Turbellarian was common at L.W.M. at Gore Point.

Phylum NEMERTINI

A single specimen of a nemertine was obtained at First Rocks.

Phylum ANNELIDA

POLYCHAETA. (Mainly determined by D. P. Wilson.)

- LEPIDONOTUS SQUAMATUS (L.). Two near Gore Point.
- HARMOTHOE IMBRICATA (L.). Common and widespread. There is some doubt as to whether the specimens are of this species or of *H. impar*. Further upriver specimens of *H. imbricata* occur, and others intermediate between *imbricata* and *impar* are also present. At Porlock the specimens are of the intermediate type and further samples and examinations will be made to determine whether *H. impar* is or is not present.
- * POLYNOË SCOLOPENDRINA Savigny. One near Gore point.
- * STHENELAIS BOA (Johnston). Two near Gore Point.
- * EULALIA PUNCTIFERA (Grube). One near Gore Point.
- NEREIS PELAGICA L. One near Gore Point.
- MARPHYSA SANGUINEA (Montagu). One near Gore Point.
- * LYSIDICE NINETTA Audouin and Milne-Edwards. Two near Gore Point.
- * ARABELLA IRICOLOR (Montagu). One.
- * SABELLARIA SPINULOSA Leuckart. One.
- * AMPHITRITE GRACILIS Grube. Common near Gore Point.
- * POLYMNIA NEBULOSA (Montagu). Common.
- * NICOLEA VENUSTULA (Montagu). Common.
- * THELEPUS SETOSUS (Quatrefages). Common and widespread.
- * POTAMILLA RENIFORMIS (O. F. Muller). Common and widespread.
- POMATOCEROS TRIQUETER (L.). Widespread.
- * FILOGRANA IMPLEXA (Berkeley). Common at Gore Point. There is some confusion between this species and *Salmacina* owing partly to faulty preservation. Further collections will be made.
- * PROTULA TUBULARIA (Montagu). Rare.
- * APOMATUS AMPULLIFEROUS Phillippi. One near Gore Point.

Phylum ARTHROPODA

CRUSTACEA. (OSTRACODA and COPEPODA were not collected.)

Sub-Class CIRRIPIEDIA. Order Thoracica

- * VERRUCA STROEMIA (O. F. Müller). Widespread and abundant near L.W.M.

CHTHAMALUS STELLATUS (Poli). Common at First Rocks.

* *BALANUS PORCATUS* (da Costa). Rare at L.W.M. in all parts.

BALANUS PERFORATUS Brugière. Rare at L.W.M. in all parts.

BALANUS BALANOIDES (L.). Spat common at First Rocks with adult *Chthamalus*, 23.3.40.

— *BALANUS IMPROVISUS* Darwin. Abundant and widespread near L.W.M.

Sub-Class MALACOSTRACA. Order Isopoda

— *EURYDICE PULCHRA* Leach. One specimen in pool at First Rocks.

— *LIMNORIA LIGNORUM* (Rathke). One (not in wood) from First Rocks.

— *IDOTHEA VIRIDIS* (Slabber). Two small specimens at First Rocks.

— *JANIRA MACULOSA* Leach. Fairly common at First Rocks.

— *JAERA ALBIFRONS* (Fabricius). Widespread and common.

— *LIGIA OCEANIA* (L.). Base of cliff near Gore Point.

Order Amphipoda

* *APHERUSA BISPINOSA* (Bate). One male.

— *CALLIOPIUS CRENULATUS* Chevreux et Fage. Three males.

— *GAMMARELLUS HOMARI* (Fabricius). Immatures common at First Rocks.

* *CHEIROCRATUS SUNDEVALLI* (Rathke). One male.

MAERA OTHONIS (M. Edwards). Rare; females without eggs.

— *MARINOGAMMARUS MARINUS* (Leach). In the Bay (FG) near L.W.M.; adults only, females without eggs.

— *MARINOGAMMARUS STOERENSIS* (Reid). One male and one female (with eggs) in the Bay.

— *MARINOGAMMARUS OBTUSATUS* (Dahl). Common near M.T.L. at First Rocks; 17 females (5 with eggs), 14 males, 2 immatures.

* *GAMMARUS DUEBENI* Lilljeborg. At H.W.M. in the stream at J, near Gore Point; 2 males, 1 female without and 2 with eggs, 1 immature.

— *GAMMARUS ZADDACHI* Sexton. One immature.

— *DEXAMINE SPINOSA* (Montagu). Two males.

— *AMPHITHOË RUBRICATA* (Montagu). Fairly common at First Rocks and common in the Bay (F) at L.W.M.

JASSA FALCATA (Montagu). Two females.

DULICHIA PORRECTA (Spence Bate). Two in pool at First Rocks.

Order Decapoda

SPIRONTOCARIS CRANCHI (Leach). Three at First Rocks.

- * SPIRONTOCARIS PUSIOLA (Kröyer). One female in berry at First Rocks.

ALPHEUS MACROCHELES (Hailstone). One in the Bay.

- LEANDER SERRATUS (Pennant). One at First Rocks.
- GALATHEA SQUAMIFERA Leach. Two at First Rocks.
- * PORCELLANA PLATYCHELES (Pennant). Rare at First Rocks.
- * PORCELLANA LONGICORNIS (L.). Abundant at First Rocks.
- EUPAGURUS BERNHARDUS (L.). Three small ones at First Rocks.
- CARCINUS MOENAS (Pennant). One female in berry from the Bay.
- CANCER PAGURUS L. Occasional, up to $2\frac{1}{2}$ " across.
- * XANTHO HYDROPHILUS (Herbst). Abundant at First Rocks.
- PILUMNUS HIRTELLUS (L.). Rare at First Rocks.

ARACHNIDA. Sub-Class ARANEAE

A Lycosid spider was abundant on the shingle rampart above H.W.M.

Sub-Class PYCNOGONIDA

- PYCNOGONUM LITTORALE (Stroem). One very small specimen at First Rocks.

INSECTA. Group APTERYGOTA

- PETROBIUS CARPENTERI (Bagn.). Specimens (probably of this species) were abundant on the shingle rampart above H.W.M.

Phylum MOLLUSCA

Many species have been identified by R. Winckworth. Names as in Winckworth, 1932.

PLACOPHORA

LEPIDOPLEURUS ASELLUS (Gmelin). One at First Rocks. (The record of *Craspedochilus onyx* which was included with *Lepidochitona cinereus* in the previous fauna list (Bassindale, 1940) referred to the present species and should have been inserted under this name.)

- * TONICELLA RUBRA (L.). One at First Rocks.
- LEPIDOKHITONA CINEREUS (L.). Several at First Rocks.

GASTROPODA. Sub-Class PROSOBRANCHIA

Order Archaeogastropoda

- * EMARGINULA RETICULATA Sowerby. Abundant and large at First Rocks, common on Gore Point.

- DIODORA APERTURA (Montagu). Rare.
- PATELLA VULGATA L. Widespread and common.
- * PATINA PELLUCIDA (L.). Abundant and large on Gore Point (BC); common at First Rocks (A).
- * PATELLOIDA VIRGINEA (Müller). Common and large at First Rocks (A).
- CALLIOSTOMA ZIZIPHINUM (L.). Fairly common all over; one albino shell from First Rocks.
- GIBBULA CINERARIA (L.). Abundant all over.
- GIBBULA UMBILICALIS (da Costa). Abundant all over.
- * OSILINUS LINEATUS (da Costa). Abundant at First Rocks; common in the Bay.
- TRICOLIA PULLUS (L.). Common at First Rocks.

Order Mesogastropoda

- LITTORINA LITTOREA (L.). Common all over.
- LITTORINA SAXATILIS (Oliv.). Abundant all over.
- LITTORINA LITTORALIS (L.). Spawn only, in all stages of development.
- CINGULA SEMICOSTATA (Montagu). Two at First Rocks.
- * CINGULA SEMISTRIATA (Montagu). Two at First Rocks.
- RISSOA PARVA (da Costa). Two at First Rocks.

Order Stenoglossa

- NUCELLA LAPILLUS (L.). Common or abundant all over; just beginning to spawn in the Bay (26.3.40).
- OCENEBRA ERINACEA (L.). Fairly common.
- BUCCINUM UNDATUM L. One large specimen.
- NASSARIUS INCRASSATUS (Ström). Several taken at First Rocks (A).

Sub-Class OPISTHOBRANCHIA. Order Acoela

- * EUPHURUS CLAVIGER (Müller). One at Gore Point (BC).
 - ACANTHODORIS PILOSA (Abildgaard). Two at First Rocks (A); both black and white specimens abundant in the Bay (FG).
 - * ONCHIDORIS FUSCA (Müller). Abundant at First Rocks.
 - ONCHIDORIS MURICATA (Müller). Two at Gore Point (BC); common in the Bay (FG).
 - * GONIODORIS NODOSA (Montagu). Common all over.
- Nudibranch spawn was fairly common.

LAMELLIBRANCHIA. PROTOBRANCHIA

- NUCULA NUCLEUS (L.). Dead valves very common all over.

FILIBRANCHIA

- ANOMIA EPHIPIUM L. Common and large at First Rocks.
- * HETERANOMIA SQUAMULA (L.). One at First Rocks.
- MYTILUS EDULIS L. Common and widely distributed in the Bay (NOP) at M.T.L.
- MUSCULUS DISCORS (L.). Five from First Rocks.

PSEUDOLAMELLIBRANCHIA

- OSTREA EDULIS L. Shell only.
- CHLAMYS VARIA (L.). One. (Winckworth says that the record of the variety *nivea* (Bassindale, 1940) is undoubtedly wrong as *nivea* is a North British form).
- CHLAMYS DISORTA (da Costa). One specimen and odd valves.

TELEODESMACEA

- * SAXICAVA GALLICANA Lamarck. Common at First Rocks. (Winckworth suggests a return to *Saxizava* until the priority of *Hiatella* is actually proved).

Phylum POLYZOA

ECTOPROCTA. Order **Gymnolaemata**

- * SCRUPARIA AMBIGUA (d'Orbigny). (Hastings, 1941.) One colony at First Rocks.
- * BRETTIA TUBAEFORMIS Hincks. Very rare at First Rocks and Gore Point.
- SCRUPOCELLARIA REPTANS (L.). Rare at Gore Point and in the Bay.
- SCRUPOCELLARIA SCRUPOSA (L.). Rare at First Rocks and Gore Point.
- BICELLARIELLA CILIATA (L.). One colony at Gore Point.
- MEMBRANIPORA AURITA Hincks. Common all over ; just beginning new season's growth.
- MEMBRANIPORA DUMERILI (Audouin). Rare at First Rocks and Gore Point.
- MEMBRANIPORA LINEATA (L.). Fairly common all over
- ELECTRA PILOSA (L.). Common at First Rocks and Gore Point ; rare in the Bay.
- ELECTRA HASTINGSÆ Marcus. One good colony seen in the Bay.
- * MICROPORELLA CILIATA (Pallas). One colony from Gore Point.
- LEPRALIA PALLIASANA (Moll). Fairly common at First Rocks and Gore Point.

- CHORIZOPORA BRONGNIARTI (Audouin). One colony from the Bay.
- * SMITTIA RETICULATA (Macgillivray). One colony from the Bay.
- MUCRONELLA PEACHI (Johnston). Abundant all over.
- * MUCRONELLA VARIOLOSA (Johnston). Rare at First Rocks and Gore Point.
- * MUCRONELLA VENTRICOSA (Hassall). Rare and widespread.
- * HIPPOTHOA DISTANS Macgillivray. Common all over.
- SCHIZOPORELLA LINEARIS (Hassall). Common all over.
- SCHIZOPORELLA SPINIFERA (Johnston). Abundant at First Rocks and Gore Point.
- CELLEPORA PUMICOSA L. One colony at Gore Point.
- CRISIDIA CORNUTA (L.). Rare at First Rocks and Gore Point.
- CRISIA ACULEATA Hassall. Fairly common at First Rocks and Gore Point.
- CRISIA DENTICULATA (Lamarck). Rare at First Rocks and Gore Point.
- CRISIA EBURNEA (L.). Common at First Rocks.
- BERENICEA PATINA (Lamarck). Abundant at First Rocks and Gore Point; not common in the Bay.
- * DIASTOPORA SARNIENSIS (Norman). Common and widespread; numerous colonies just starting.
- TUBILIPORA LOBULATA Hassall. Two colonies at First Rocks.
- TUBILIPORA LILIACEA (Pallas). Fairly common at First Rocks and Gore Point.
- LICHENOPORA HISPIDA (Fleming). Common and widespread; numerous very small colonies.
- ALCYONIDIUM HIRSUTUM (Fleming). Fairly common at First Rocks and Gore Point.
- ALCYONIDIUM POLYOUM (Hassall). Common at First Rocks and in the Bay.
- FLUSTRELLA HISPIDA (Fabricius). Common at First Rocks.

ENTOPROCTA

- PEDICELLINA CERNUA (Pallas). One colony at First Rocks.

Phylum ECHINODERMATA

OPHIUROIDEA. Order Ophiuræ

- AMPHIPHOLIS SQUAMATA (Delle Chiaje). One at First Rocks.
- * OPHIOTHRIX FRAGILIS (Abildgaard). Common, especially at First Rocks.

ECHINOIDEA. Order Diadematoidea

* *ECHINUS ESCULENTIS* L. Common in the Bay.

HOLOTHUROIDEA. Order Dendrochirota

* *CUCUMARIA SAXICOLA* Brady and Robertson. All sizes common at one place at First Rocks.

Phylum TUNICATA

Several species of solitary Ascidians were present but have not been determined. No colonial forms were observed.

Phylum VERTEBRATA**PISCES. Sub-Class OSTEICHTHYES. Order Teleostei**

-- *BLENNIUS PHOLIS* L. (The Shanny). One in each pool at First Rocks.

TABLE 1

The number of intertidal species recorded from Porlock Bay during equinoctial spring tides in March, 1940

Phylum	Number of species recorded.	Number of species not yet recorded elsewhere on the coast	Number of species previously recorded upriver of Porlock
Porifera	4	1	0
Coelenterata	2	1	2
Platyhelminthes	2	0	1
Nemertini	1	0	?
Annelida	19	14	5
Arthropoda	39	12	22
Mollusca	37	11	24
Polyzoa	34	8	8
Echinodermata	4	3	1
Tunicata	(2)	0	0
Pisces	1	0	1
Total	145	50	64

From the figures which summarise the fauna list (Table 1), certain characteristics of the fauna become apparent. The most abundant

groups are the Arthropoda, Mollusca, Polyzoa and Annelida, in that order. This is normal to a marine fauna except that the Polyzoa are somewhat better represented than is usual. Another feature is the absence of hydroids. It seems possible that the absence of hydroids is due to the storm-washed nature of the beach and that, in the absence of the hydroids, the more sessile encrusting colonies of Polyzoa have developed abundantly.

Compared with Blue Anchor Bay and further upriver, the fauna is augmented by the appearance of 81 new species. Among these are 4 sponges, 14 annelids, 17 arthropods, 13 molluscs, 26 polyzoa, 3 echinoderms and at least 2 tunicates. It is apparent that, whereas the more abundant groups are gradually increasing in numbers of species as the Channel is descended, the conditions at Porlock are becoming so free from estuarine influence that truly marine groups are obtaining a foothold.

The Bristol Channel fauna list previously published (Bassindale, 1940) contains the names of a very large number of species which were recorded from stations upstream of Porlock but which were not found at Porlock itself. Of these, however, some species are brackish-water types, some, such as sand or mud dwellers, live in conditions not present at Porlock, and others are species not likely to be taken by hand collecting on the shore or unless specially searched for. Accordingly, the fauna list has been examined and all species occurring above Porlock marked. Of these a list was prepared omitting such forms as were not likely to be present at Porlock for any of the above reasons. This list of over sixty species included many forms which were rare or very local. After omitting these the list was reduced to the following nine species :—**Tubularia indivisa*, *Sertularia cupressina*, *Tealia felina*, *Sabellaria alveolata*, **Sphaeroma serratum*, *Idotea granulosa*, *Melita palmata*, *Gammarus locusta*, **Bowerbankia imbricata*.

From monographs on the various groups it seems that all these species should occur on a marine beach such as that at Porlock, and their presence higher up the Channel makes their absence remarkable. At Plymouth, however, the 3 species marked with an asterisk have not been recorded outside the Sound or adjacent estuaries and *Sertularia cupressina* is known to be more abundant in estuaries than in the open sea. Their distribution may be similar in the Severn Estuary, thus accounting for their absence at Porlock. In the case of *Idotea granulosa* and *Melita palmata* the species were nowhere abundant

and they may have been overlooked. *Gammarus locusta* was expected to appear in abundance at some station seaward of Blue Anchor (Bassindale, 1942B) but apparently the station has not yet been reached. For the remaining two species—*Tealia felina* and *Sabellaria alveolata*—no explanation of their absence can be suggested. It is significant that *Sabellaria spinulosa* is present and this perhaps indicates a change in conditions sufficient to exclude *S. alveolata*.

In comparing the marine intertidal fauna of different stations, graphs (Figs. 9 and 10, Bassindale, 1943) gave the numbers of species actually recorded at each station and the numbers assumed to be present because of their presence elsewhere. The two values for Porlock are 138 and 258 species respectively when all records are included, and 138 and 212 when records of the present survey are alone considered.

Owing to the recording from Porlock of 47 sessile species not previously recorded from the coast, the "assumed" fauna of Ilfracombe in the same graphs becomes 451 instead of 404.

SUMMARY

A survey of the intertidal fauna of the Severn Estuary and Bristol Channel has been extended seawards by collections made in March, 1940, at Porlock Bay. Of the 144 species recorded in the fauna list, 50 are new records for the coast and 80 have not been recorded upriver of Porlock. The fauna is characterised by the absence of hydroids, which may be attributed to the storm-washed nature of the beach, whilst Polyzoa are unusually abundant.

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Studies on the Biology of the Bristol Channel

XIV

ELVERS IN THE SEVERN

By L. HARRISON MATTHEWS, M.A., Sc.D.

(Received, Feb. 16, 1943)

THE life history of the Freshwater Eel, which for so long remained a mystery, has been very largely unravelled during the past twenty years. For long it was known that eels are normally without roes, and consequently cannot spawn; and thus began the legend that eels originate from horse-hairs that chance to fall into the water. In the autumn a migration of eels takes place down our rivers towards the sea, and these migrating eels differ so much from those which remain in freshwater that many fishermen believe there are two sorts of freshwater eels, the Broadnosed, and the Sharpnosed or Silver Eels. The Broadnosed Eel has a blunt snout, small eyes and is greenish or yellowish in colour, but the Sharpnosed Eel has a pointed snout, large eyes, and is silvery in colour, especially on the belly.

The Broadnosed Eel is the form which is usually found in rivers, lakes and ponds, where individual fish may live for many years until a great change comes over them; their snouts grow pointed, their eyes grow large, their colour changes to silver, and an instinct develops which drives them down to the sea in their new shape as Sharpnosed Eels. In the sea the eels from European waters travel south and west, probably at great depths in the ocean, until they arrive at an area beneath the Sargasso Sea east of the West Indies. During the journey, the roes of the eels have developed from minute rudiments, so that by the time of arrival at the appointed place they are ripe for spawning. Here, a mile or more below the surface, the eggs are laid and fertilized and the parents probably perish, for it is certain that they do not return to the fresh-waters.

The fertilized eggs float to the surface layers of the sea and there hatch, giving rise to minute transparent larvae. The young eels, in

their larval state, are not in the least like their parents, but are leaf-shaped or lanceolate, being flattened from side to side like a ribbon, and are quite transparent, the only colour being the black pigment of the eyes. When first discovered, over a hundred years ago, the larval eel was thought to be a distinct species and was named *Leptocephalus morrissi*, so that the larval stage is nowadays known as the leptocephalus stage of the eel. In the upper waters of the sea the leptocephali feed upon the minute plants and animals of the plankton, of which, indeed, they themselves form a part. Here they feed and grow for three years, drifting always eastwards in the water of the Gulf Stream. By the time they are three years old they are near the coast of Europe, and are about four or five inches long, about one inch from back to belly, but less than a tenth of an inch thick. Then they undergo a metamorphosis which turns them into miniature eels. They shrink a little in length and a great deal in depth, so that they are no longer leaf-shaped but cylindrical, about four inches long and about a tenth of an inch in diameter, but they are still completely transparent, except for two black spots which are the eyes. In this stage they are known as Glass Eels, and they are now close to the European coast, where they develop an instinct to enter fresh-water at the mouths of rivers and streams.

Glass Eels start to become coloured as they enter fresh-water. The colour first appears upon the back, and then spreads over the rest of the body until, by the time they are well in the estuaries, the Glass Eels have become light green colour and are now known as Elvers. The elvers arrive in the British estuaries in the early months of the year and swim up the rivers in enormous numbers about the time of the spring equinox, and nowhere is the ascent of the elvers a more conspicuous phenomenon than in the Severn. From the rivers the elvers disperse into all the tributaries, and even make their way over land through damp herbage to isolated ponds and lakes that have no direct communication with the rivers. As they increase in size the elvers become eels; there is no exact dividing line between the two—it is merely a question of size. In fresh-water, eels may live for as much as eight or ten years as Broadnosed Eels, and may reach a weight of three or four pounds or more. Then comes their final metamorphosis into Sharpnosed Eels and their return to the sea and the distant spawning grounds near the West Indies, from which they never return.

From time immemorial there has been a fishery in the Severn to take toll of the swarms of ascending elvers every spring. For

although elvers are very tiny fish, they are available in such enormous numbers that they are a valuable and nutritious article of food. The present day methods of the fishery are probably identical with those of old custom, and they are very simple. The elvers are so abundant at the appropriate season that the fishermen merely stand on the river bank and dip out their catch with a fine-meshed net mounted on the end of a pole. Best results are obtained at night, when each fisherman has a lantern beside him on the bank and the elvers are attracted to his neighbourhood by the light. So many fishermen work the night spring tides that on such occasions the river, with its rows of lights, has been likened to a city street.

The net used in the elver fishery is of peculiar local design and has been well described by Lloyd (1940) as consisting of a U-shaped piece of board about $2\frac{1}{2}$ feet in diameter with a stout handle about 7 feet long passing through a hole about 3 ins. below the straight edge. Two withy rods are fixed to the upper sides of the U and extend forwards about 5 feet to the front of the net. Here they are joined by the leading-string which is about 3 feet long. Two cross withies extend from the same point, crossing in the centre and fixed to the back board. The handle is firmly fixed to the point of intersection. This framework is covered with cheese-cloth or sacking. The wire covers used for protecting meat are also often fixed on handles and used as nets. Before the elvers are cooked they are freed from slime, either by washing them in a colander under the tap or by pressing them in a cheese-cloth. They are then usually fried and make a most delicious and nourishing dish. If they are pressed strongly when being prepared for cooking they are compressed into cakes which can be cooked as a whole. Day (1890) mentions that three tons weight of elver cakes were despatched from Gloucester one day in May 1886.

Day also relates that the "elvers had been protected by legislation from the time of Charles II, but in the reign of George III so much of the former act was repealed as related to a penalty on persons taking elvers for their own use and not for sale. But the Salmon Act of 1861 repealed the previous legislation and the destruction became so excessive that an official enquiry was made at Gloucester which resulted in the present law which authorises their being taken between March 1st and April 25th only. By some error this was not made to have effect in the hundred of Gloucester where the destruction of young eels goes merrily forward." The open season for elvers remains from

March 1 to April 25, which allows only four spring tides at the most for the fishery.

But the culinary use is not the only purpose for which elvers are caught, for, if kept alive, they can be used for stocking lakes and rivers to which elvers do not ascend naturally. For this latter purpose a German Association, the *Deutsche Fischerie Verein*, has for many years maintained a collecting station at Epney, near Gloucester, from which elvers were exported for stocking lakes and rivers in Germany.

The Elver Fishery Station at Epney is about five miles down the Severn below Gloucester. It lies very close to the river and is separated from it only by the embankment. The land on which the station stands forms part of the premises of the Anchor Inn, and was rented from the Stroud Brewery Co. Ltd., the station itself belonging to the *Deutsche Fischerie Verein*. The station is enclosed within a boarded fence six to seven feet high. Within it are a reception and weighing room, an engine house, a tank enclosure and an open-sided storage shed.

The reception room has a concrete floor with a drain. When the elvers were brought to the station in buckets of water, the buckets were emptied with a strainer over the drain and the elvers weighed and passed out to the tank enclosure.

The engine house contains a 5 h.p. Lister petrol engine which drives a two cylinder plunger pump by means of belt and pulleys. The pump was used for maintaining a circulation of fresh-water from the river through the tanks in which the elvers were stored before shipment.

The tank enclosure, which is unroofed, contains four galvanised steel tanks, each approximately fifteen feet long by four feet wide and three deep. Water can be delivered to the tanks by a system of pipes. The main supply pipe for each tank is a $\frac{3}{4}$ inch galvanised pipe which runs the length of the tank in its upper edge. From the main pipe six $\frac{5}{8}$ inch branch pipes dip to the bottom of each tank, where the water is delivered. Each branch pipe is controlled by its own wheel valve. The main pipes are also provided with valves so that water can be delivered to any tank individually. At one corner of each tank there is a small compartment divided from the tank by a partition of wire gauze through which the water can flow, but the elvers cannot escape. Within the compartment is the overflow pipe which extends from a hole in the base of the tank to about four inches from the top of the tank, at which level the depth of water is maintained. The tanks are provided with an additional drain pipe in the bottom, for use when

they are cleaned out. The tank enclosure is provided with duckboards raised above the level of the bottom of the tanks so that those in charge are at a convenient height for working with the tanks. The tanks are set on concrete foundations raised above the surface of the ground.

Water was drawn from the river by means of a three inch pipe which ends at a large suction box near the level of low-water of spring tides. At spring tides, when the scour of the river brings a lot of silt into suspension, water was drawn by another three inch pipe from a nearby brook. This was done to save wear on the valve seatings and plungers of the pumps. But water was taken from the brook as little as possible because it was essential to keep the temperature of the water in the tanks as close as possible to that of the river. If the temperature were allowed to rise much above it the elvers would die.

The storage shed is about forty feet long and eight wide, and is used for storing the boxes and trays in which the elvers were packed for export.

When the station was in use the elvers were caught by fishermen who brought them to the station in buckets of water. The elvers were then weighed and placed in the tanks where they were stored until a sufficient quantity had been collected. They were then dipped out and packed for transport.

The elvers were packed in special trays. Each tray consisted of a wooden framework about two and half feet long, one and a half feet wide and two feet deep, with the bottom made of cheese-cloth. A batten divided each tray transversely into two equal compartments. Each tray held three pounds of elvers, half in each compartment, and when filled the trays were packed one above the other in wooden cases built to fit them. Each case held about twelve trays, and the top tray differed from the others. It had two flat battens transversely across the bottom and was not divided into compartments. In it were packed a layer of wadding soaked in water, and a quantity of ice. The case was then closed for transport.

Each shipment of elvers was sent to Gloucester by lorry and then sent by rail in a special van to Grimsby where the cases were opened and water was poured into the wadding of the top trays and a further supply of ice was added before shipment to Hamburg, where the process was repeated. From Hamburg the cases were distributed to their destinations in Germany. Labels affixed to the cases carried warnings against shaking or tilting them.

The elvers were caught by independent fishermen, not employed by the station, who sold their catches to it. Because of the night work involved, the German formerly in charge of the station had a bed in the reception room, on which to take his ease while waiting for the fishermen to come in. It may be mentioned that this man, Herr Timmins, had paid a yearly visit to the station since the last war and was also regularly working at it prior to 1914. When the writer saw him several years ago, he was an elderly man who was most friendly to interested visitors to his station. The station was practically rebuilt after the last war, during which it stood derelict.

Elvers are caught in greatest quantities at the spring tides during March and April, but any tide over 26 feet is regarded as a suitable one for elver fishing. The yearly catch exported by the station varied from 4,000 to 8,000 lbs of elvers; in 1939 the quantity was over 7,000 lbs. The station paid the fishermen 1/- a lb. for live elvers, whereas the local value of them for culinary purposes is about 2d. or 3d. a lb. The fishermen were not paid at the time when they delivered the elvers, but were issued with a ticket showing the weight received. The tickets were redeemed at a later date and checked against their counterfoils which were retained at the station.

Nearly all of the annual catch of live elvers was sent to Germany, but a small proportion, between 60 and 100 lbs., was sold to buyers in this country and Ireland, rather more going to Ireland than to Great Britain. At the beginning of the season there are about 950 elvers to the pound; the number increases to about 1,000, and reaches about 1,200 to the pound at the end of the season. If the average is taken at 1,000, it will be seen that the catch for 1939, the last season in which the station was working, was over 7,000,000 elvers, for which the station paid out over £350 to the fishermen.

The Ministry of Agriculture and Fisheries have now acquired the station, and used it for stocking British rivers in the 1943 season.

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Seventeenth Century Observations on Rocks, Minerals, Fossils, etc., of Gloucestershire and Somerset

By STANLEY SMITH, M.A., D.Sc., F.G.S.

(Received, March 6, 1943)

WHITTAKER and Woodward overlooked very little when, in 1875,* they compiled their *Chronological list of Books, Papers, &c. on the Geology, Mineralogy, Palæontology, &c. of Gloucestershire and Somersetshire*, which carries us as far back as the year 1557; neither did Whittaker in his *Bibliography—Bath Thermal Waters* which begins with 1568.† One work, however, escaped their notice—*Britannia Baconica* by J[oshua] Childrey, 1661, London, 12mo., pp. xxviii + 1-184, the title page of which is reproduced opposite.

The author dedicates the work to Henry Somerset, Lord Herbert (created in 1684, 1st Duke of Beaufort) and then in the preface tells the reader that "this book is intended for the use of the vulgar" and "the service of the gentry," to teach the former "not to mis-believe or condemn for untruths all that seems strange and above their wit to give reason for" and that the latter "may see England is not void of those things which they admire abroad in their travels." He illustrates his second remark by giving several examples, a few of which are particularly worth mentioning: "As Italy hath Virgils Grott, and the Sybils Cave by Puteoli; so England," he says, "hath Okeyhole [Wookey Hole] by Wells. We have *Baiae* at Bath; the Alps in North Wales; . . . the Pyramides at Burrowbrigg [Boroughbridge, Yorkshire—Childrey is referring to the Devil's Arrows], the Pearls of Persia on the shores of Westmorland; and the Diamonds of India on St. Vincents Rock."

Childrey collected most of his subject matter from sources already published, but he also records various observations of his own and gives information imparted to him by those with whom he had come in

* Appendix III (pp. 216-255) of H. B. Woodward and others, 1876, *Geology of East Somerset and the Bristol Coalfields. Mem. Geol. Surv. England and Wales.*

† Wells and Springs of Somerset, 1928. *Mem. Geol. Surv. England*, p. 263.

contact; moreover, his borrowings from previous writers are very often punctuated by his critical comments and discursive remarks.

Britannia Baconica:
Or, The Natural
RARITIES
O F
England, Scotland, & Wales.
According as they are to be found in every
S H I R E.
Historically related, according to the Pre-
cepts of the Lord Bacon; Methodically dige-
sted; and the Causes of many of them
Philosophically attempted,
WITH
Observations upon them, and Deductions
from them, whereby divers Secrets in Nature
are discovered, and somethings hitherto
reckoned Prodigies, are fain to confess
the cause whence they proceed.
*Usefull for all ingenious men of what Profession or
Quality soever.*

By *F. CHILDREY.*

Res semper aliquid apportat novi. Terent.

LONDON, Printed for the Author, and are to
be sold by H.E. at the sign of the Grey-hound in
St. Pauls Church-yard, 1661.

From the title page one might reasonably infer that *Britannia Baconica* was only concerned with the unusual and outstanding, but this is by no means the case. Its author mentions much that is

commonplace, and on that account is the more interesting, particularly to us who read the book two hundred and eighty years after it was written. He has usually something to say concerning the climate, soil, topography, and agricultural and mineral products of the counties. His observations on Gloucestershire begin with the statement that "The hilly part of this country (called *Castwald*) abounds with fine wool, small sheep which are long-necked, and square of bulk, and bone) and hath a very pleasant air: The low parts of it are exceeding fruitfull and rich in Corns" and his opening remarks on Somerset are "In this Shire the Air is mild, and the soil generally very wet, miry, and moorish."

Although we are told by Childrey that he has "not at all meddled with matters of antiquity, pedigrees or the like," nevertheless he does occasionally refer to things which fall within the province of archæology. He discusses Stonehenge at considerable length but in this case he is undecided as to whether he is dealing with something that is natural or is the work of man.

The counties receive unequal treatment. Cornwall occupies twenty-eight pages, Montgomery three lines and the whole of Scotland is covered in six pages.

Most of the "natural rarities" of Gloucestershire and Somerset, it so happens, fall within the scope of either mineralogy or geology. They include minerals, rocks, fossils, and, as one would expect, the thermal springs of the Avon valley. The account Childrey gives of these thus constitutes an integral part of the geological literature of the two counties, and at the same time the ideas he expresses illustrate the opinions of the period. The passages therefore possess both a local and a general value. The more important and interesting paragraphs are reprinted here exactly in their original form; their order is, however, slightly changed. This alteration has been made so that kindred subjects are brought together under their proper headings.

Undue emphasis must not be placed on the apparent puerility of the scientific outlook which these extracts portray. In 1661, ideas concerning the constitution of matter and geological processes remained much as they were when Pliny wrote his *Natural History*. We owe a great debt to *Britannia Baconica* and similar works published during the latter half of the 17th and early part of the 18th centuries. They stimulated that interest in nature and in the past which made possible the great progress science achieved within the next few decades.

A short account of the author of *Britannia Baconica* must not be omitted. For my information I am indebted to the Rev. A. S. Bryant, present Rector of Upwey, and the *Dictionary of National Biography*.

Joshua Childrey (1623-1670) was born at Rochester. He received his earlier education at Rochester Grammar School and proceeded in 1640, at the age of seventeen, to Magdalen College, Oxford, where he obtained a clerkship. He left Oxford at the beginning of the Civil War, 1642, but returned after its capitulation to the Parliamentary Forces, 1644. He graduated in 1646, Bachelor of Arts, was subsequently ordained, and took his M.A. degree. He remained in residence at the University until 1648, when, so it is generally supposed, he was expelled. During the Protectorate he maintained himself by teaching at Faversham, Kent. After the Restoration, Lord Herbert appointed him one of his chaplains, and in the same year (1660) he received a Doctorate in Divinity. Through the influence of his patron preferment followed. In 1663 he obtained the Archdeaconry of Sarum, and in 1664 the Prebendal Stall of Yetminster Prima (Hants) and the rectory of Upwey, Dorset. He died, at the comparatively early age of 47, on 16 Aug., 1670, and was buried in the chancel of Upwey Church. Childrey was a keen naturalist and antiquary. He was also interested in astrology and during the Commonwealth published two works on the subject.

I. MINERALS

Bristol diamonds.¹ "On the upper side of these craggy Rocks of *St. Vincent*, are digged out pellucid stones,² sex-angular (or six cornered) and quadrangular, (or four cornered) which we call *Diamonds*. Some will have them to be Chrystal, but (saith Mr. *Johnson*) I think they are rather of the nature of *Fluores*. For (saith he) I remember an Apothecary of *Bristol* told me, the Lord of the place would not have them taken out of the Iron Mine, (which was the womb in which they were formed) because the greater quantity of them make the Metal the more fluid, and apt to melt. And *Agricola*³ tells us, that *Fluores*⁴ are very like *Diamonds*, but not so hard, and that they are used in the melting and trying of Metals, till they be thoroughly tried; for (saith he) they make the matter in the fire much more fluid. And *Kentmannus*⁵ in his Catalogue of *Fossils*, reckons Pellucid *Fluores*,⁶ sexangular, and like Crystal. Of these *St. Vincent Stones*, *Cambden*⁷ speaks thus: They are (saith he) so plentiful there, that one may fill a bushel with them; and they are all either four cornered, or six

cornered.⁶ And saith *Speed*,⁸ saving their hardness, they are as good as the *Diamonds* of *India*. (p. 37).

On another Rock more Western then *St. Vincents* Rock, there are found *Diamonds* enclosed in hollow and reddish Flints after a wonderful maner, and the Earth it self is red there too⁹." (p. 36) [38].*

Lead Veins. "*Mendip-Hills* in this shire afford great abundance of Lead.¹⁰ I have heard it reported, that the Lead Ore in these hills is found by a very strange means.¹¹ There are men; they say, that go up and down upon the hils with forked hazle-wands in their hands near the places, where they suspect the Ore to be; And the nature of the wands is, that when they pass over a place where Ore is, they bend and draw down to the Earth towards the Ore of their own accord; and so they Ore is found. They say likewise, that any hazle wand wil not do it, but that these we speak of, are prepared after a secret manner, the mystery of which is kown but to some very few men there who make a living out of this Art of theirs, by finding out the Ore for the owners. This story is very strange, and unlikely to be true: nor could I have given any credit to it, had I not read in *Sebastian Munsters Cosmography*, that in the Silvermines in *Germany* the place where the Ore lies, and the veins run, is found by this very means of Hazle-wands. . . . Besides this I remember very well that the *Necromancers* have a kind of rodde, called *Mosaicall* rodde (which are nothing but Hazle-wands, cut upon such a day of the week, under such a constellation, and prepared with abundance of ceremonies and circumstances partly Sottish, partly impious) the vertue whereof they say, is to find out treasure hidden in the groand." (p. 44.)

NOTES

- ¹ In this early description of "Bristol diamonds" two minerals are clearly involved. The one described as being rather "of the nature of fluores" is calcite, the other "enclosed in hollow redditsh flints" is quartz—that is, the true "Bristol diamond."
- ² Calcite. 'Sex-angular' describes the crystal, 'quadrangular' the cleavage rhomb; calcite crystals frequently fill or line open joints in the limestone which are particularly numerous in the higher beds.
- ³ Georg Bauer (Georgius Agricola 1494-1555), a physician who practised at Joachimsthal in Bohemia and later at Chemnitz, Saxony—both places were important mining centres. Bauer, interesting himself in mining, metallurgy and minerals, became

* pp. 32 [33]—55 [47] pagination is incorrect.

the authority on these matters for the next two centuries. In very many respects he was greatly in advance of his time and is rightly considered the founder of modern mineralogical science. Among his works most quoted are *Bermannus*, 1530, *De Natura Fossilium*, 1546, and *De Re Metallica*, 1556.

- ⁴ The 'fluores' of Agricola is mainly fluorite. Fluorite and calcite both serve as fluxes. Fluorite, although not entirely absent, is very uncommon in the limestones of the Avon Gorge.
- ⁵ Johann Kentmann, a contemporary of Bauer, and a medical practitioner at Torgau near Leipzig, was a keen collector of minerals, etc. He published a descriptive catalogue of his collections under the title of *Nomenclaturae Rerum Fossilium quae in Misnia praecipue et in aliis quoque Regionibus inveniuntur*, Zurich 1565, to which Childrey refers.
- ⁶ Calcite.
- ⁷ William Camden (1551-1623), celebrated antiquary and historian. His most outstanding work *Britannia*, 1586, is a general survey of the antiquities, etc. of the British Isles.
- ⁸ John Speed. 1552?-1629. Cartographer, historian and member of the Society of Antiquaries, was a tailor by trade. Acquiring a little property, he devoted himself to producing maps and to historical research.
- ⁹ The passage describes unmistakably the hollow 'potato-stones' (pl. 14, fig. 1) which are found in the Keuper marls and in which the "Bristol diamonds" occur. These geodes, which are usually three to six inches in diameter, are spheroidal or ellipsoidal in form and their rough exterior is of the same chocolate colour as the marl in which they are embedded. Thus their popular appellation is not altogether inappropriate. They consist of a comparatively thin, compact shell only one quarter to one half an inch in thickness, formed of minute crystals of semi-opaque calcite. Its inner surface provides a wall to which are attached perfectly formed crystals of clear quartz about half an inch in length. The formation of these 'potato-stones' is enigmatical and presents a problem which invites closer investigation. A geode is usually mineral matter lining a cavity, but in this case it is inconceivable that such a cavity could have existed in the soft marl. The calcite shell may have developed around a nodule of more soluble mineral such as celestine, or the hollow crystalline structure may represent a solid segregation of impure calcium carbonate which has undergone subsequent recrystallization. In either case, the presence of water and the removal by solution of mineral matter are implicated. The deposition of the quartz was a subsequent process. Both Professor W. F. Whittard and Dr. A. K. Wells, with whom I have discussed the subject, have suggested that the silica may have been in a colloidal

condition. Shrinkage of the original nodular mass is also possible, and in this connection attention may be drawn to the hollow dolomitized limestone fragments sometimes found in Permian and Triassic breccias and to the beekitized pebbles of Devonian limestone in Permian pebble beds of South Devonshire.

- ¹⁰ Lead mining in the Mendips had reached its peak at the time *Britannia Baconica* was written. Later in the 17th century decline set in. The industry was throughout carried on by small companies and never by big concerns. For an account and history of lead mining in Somerset, see J. W. Gough, 1930, *The Mines of Mendip*, Oxford.
- ¹¹ It is interesting to find in his account of divining for lead in the mendips that Childrey expressed doubts concerning dowsing, especially when we remember that the belief in this "art" or "gift" still persists and that recent attempts have been made to vindicate and explain on scientific principles a practice which has its origin in mediæval magic.

II. ROCKS

The following remarks refer to Coal Measure sandstone and to limestones, etc., of Middle Jurassic age.

"At *Puckle Church*¹ (about 6 miles from *Bristol*) they dig a kind of Stone that is hard, blewish, broad and about halfe a foot thick, and so even, and the sides so parallel to each other, as if nature had intended it for Tombstones. The stones are many of them of a very great breadth and lye some six or seven of them one under another in beds and of about the same thickness all of them; and then they come to a light blewish Clay, below which is no more of this stone to be found. The uppermost bed of the stone lyes very near to the surface of the earth, so that in one place near the Town in the high way a man rides for ten peirches or more, as if he rode upon a pavement of broad stone; or rather upon one entire stone." (p. 82.)

"At *Tormanton*, (commonly called *Tormarton*) by *Sodbury* is a Quarry of Free-stone,² and several others there are about the Countrey. All kinds of stone are not to be found in one kind of earth, but several soils afford several kinds of stone. Chalky countreys afford Flint; Sandy (if they find any) a great rough stone, generally (I think always) of the colour of the Sand where it is; *Loamy*, a kind of lightish red bastard Flint, such as is to be found in many places in the road way between *Rochester* and the top of *Boxley-hill*; Gravelly Pebbles,³ and clayie Countreys, in some places afford hard, rough, whitish stone,

and in other places Free-stone, according to the difference of the Clay. It seems every soil is most apt to afford that stone that is most of kin, and nearest of nature to it. And therefore it may be, it is the less wonder that Chalky ground should afford Flint, because Flint (like all pellucid substances) being pulverized, becomes almost perfectly white like Chalk. I have no more to add of the Freestone of *Tormarton*, but that if it be nearly viewed with a diligent eye, it seems to be nothing but an infinite number of little Grains of Gravel cemented together into a Mass, which I think will be found true of all Free-stone." (p. 80.)

NOTES

¹ Childrey's account of the rock which underlies Pucklechurch describes very graphically the thinly bedded, flaggy types of the Pennant sandstone of the higher Coal Measures.

² The geological formation which outcrops most widely around Tormarton is the Great Oolite. The 'freestone' mentioned as having been quarried there is, Mr. F. G. Hudson informs me, undoubtedly the hard, shelly bed which lies at or near the base of the series. Childrey's description of the rock as "an infinite number of little grains of gravel cemented together into a mass" is very apt although the grains are not quartz but calcareous particles.

The freestone at Tormarton (Tormarton is now the accepted name of the place) recalls to the author's mind rocks he had seen in other parts of England and affords him an opening for expressing his views on the genesis of stones. His permissible digression is interesting. He recognised that a relationship exists between soil and stones but he did not appreciate the true facts. He believed that the soil produced the stones and not that the underlying rock gave rise to the soils by its disintegration. He was entirely unaware that the rocks he mentions were formed at different periods and was unable to differentiate between autochthonous soils and deposits such as alluvium and drift. It was not until a much later date that these matters were generally and clearly understood. A belief that stones grow in the soil is not entirely obsolete, even to-day. In fact, the idea is more widely prevalent than one would suppose, considering the spread of education. This arises from a misinterpretation of a common observation, namely, the reappearance of stones at the surface of ground that had been cleared. The explanation is simple. Surface soil is being continuously removed by rain and wind, and is, moreover, being persistently drawn downwards by the earth worm and other inhabitants of the ground. Thus the coarser fragments multiply relatively at the surface.

³ What Childrey means is that gravelly regions yield pebbles.

III. FOSSILS

“ In the fields about *Badminton* are found many times *Cylindrical* stones,¹ long and round, like a mans finger. The inner part of them is like flint, somewhat pellucid, and of a sad brown colour, and it is enclosed round on the outside with a whitish *Putamin*, like Flint too.” (p. 74.)

“ At *Alderley*² (saith *Speed*) a Countrey Parish 8 miles from the *Severn*, upon the hills, to this day are found Cockles, Periwinkles, and Oysters of solid stone. This place being but four or five miles from *Badminton*, the seat of that noble Family, that I have the honor to be a servant to, I have very diligently examined, and found it thus: The place where the stones are found, is partly a Sand, and partly a Clay; Cockles I found, but neither Periwinkles nor Oysters: But though I found not them, yet instead of Periwinkles I found many Serpentine stones (or Snake stones,³ as they call them thereabout) flat, resembling the banner of *Dan*,⁴ as it's given in the Genealogies at the beginning of some of our *English* Bibles And instead of Oysters, I found Scallops,⁵ perfect fragments of them I mean (pardon the seeming contradiction) which I conceive had been broken with Ploughing: They were exactly ridged in rows at certain short distances, just like a *Scallop-shell*. Moreover, an honest inhabitant of the parish bestowed upon me a whole *Scallop*, that is somewhat bigger then the ordinary size of *Scallops*, with a perfect shell upon it, ridged (as is before said) very naturally, and having an irregular piece of stone growing to it. No man that looks upon it, would at first sight imagine it to be other then a true *Scallop-shell*, so curiously it represents it in its colour, and onely exceeds it a little (as I said) in its dimension. Besides these, I found other figured stones, some resembling very much the Muscle-fish⁶; but they were somewhat bigger too, then what they were like; and others like the Kernel of an *Almond*,⁷ long, and somewhat roundish, with two edges opposite to each other, and they were streaked and cranked like a Cockle-shell. Other little stones I found, somewhat bigger then a *Hazel-Nut*,⁸ and some much less, that were cranked in like a Cockle-shell, but deeper, and not so thick together as a Cockle-shel: Some of them did resemble also the Cockle very near, other not so much; yet all did so sufficiently differ from the form of it, at the supposed opening place of the Cockle, that a man may easily judge that they never were Cockles; for there the two shels were bent up in the fashion almost of a blobber-lip. And that which is not unworthy our considera-

tion, is, that they are few of them like one another ; some being flatter, others more round ; some have the lip more turned up, others less. They have upon them a whitish shining shel, and within they are (for some I have broken) a mass of little particles, of a pellucid matter (somewhat like *Alabaster*) grown hard together. The countrey hereabout for some miles round upon the hills, affords many of these last sort of stones ; for I have found them in gravel that was digged in *Badminton*, and sometimes I have found of them growing to great irregular stones about the countrey. I have been told that about *Sapworth* by *Sharston*, there are abundance of them to be found. I found one of them in *Witney* Town, seven Miles from *Oxford*, upon a paved Causey : How it came there, I know not, nor had I time to enquire whether the countrey thereabout afford any store, or any more of them. The Snake-stones I spoke of, have a perfect *spina* running all along the back of them (as those also at *Keynsham* have ; but those at *Keynsham* are much bigger than those at *Alderley*, and lye in another manner) with little ridges (like ribs) on both sides of them, all along from the head without, to the tail within, in the form almost of a *Roman S*. and in this they agree with those of *Keinsham* too. Further, the outer part of this snaky wreath is divisible, and may be knocked off from the inner part of the wreath to which it is joined, without taking from it, or losing to it ; so that it is not one entire Stone throughout, but is within, as it seems without, separable with a little violence ; and in this too they agree with the Snake-stones of *Keinsham*. Lastly, on the outside they have a kind of skale,⁹ thin and shining, as if it were a little polished ; in some whitish like *Alabaster* ; in others brownish, of the colour of a dried Eel-skin ; and in others again of a dirty yellow colour, inclining something to red. My opinion of all these stones, for many reasons, is that they are not Shel-fish petrified (as some would have them to be, who think that upon the ebb of the deluge these fish were left upon the tops of hills, and turned to stone by degrees, wanting their former moisture to keepe them soft within, like other Shelfish.) For first, they are all solid within, without any cavity, even the Muscles, Cockles, and Scallops. Again, some of the Muscles, Cockles, and Scallops, are a great deal bigger than true ones. Thirdly, the Snake-stones are without heads generally, if not all ; for as for those appearances of heads which some fancy at the outer end of some of them, I take them rather for irregular pieces of stone, and as it were attempts of Nature to continue the wreath further on ;

but as all works of Nature are finite, she being here at her *Ne-plus-ultra*, is not able to produce what she would, but doth what she can toward it, which is but an imperfect Lump, even as a weak Womb produces a Moon-Calf. Fourthly, some of these Mock-fishes have but half their shapes, the other part being an irregular and deformed Mass, Nature as it were failing in her Workmanship, for want of fit matter in that place. Nay one of the Snake-stones I gathered, hath a Segment (as I may call it) of another less Snake so joined to the side of it, that there can be no room for the other side of the Segment, but in the very body and bulk of the greater. And one of the Cockles I gathered (being indeed but halfe a Cockle, nothing but one Cockle-shel, with a lump of irregular stony matter in the cavity of it) hath within the hollow of the shel almost joining to it, another little Cockle-shel peeping (as it were) out of that irregular stony matter I speak of. Fifthly, these stones are not so absolutely like those creatures they would seem to represent petrified as they should be; for there is an apparent difference between the *Muscle stone*, and the true *Muscle* of the sea, both in the shape of the stones, and in the cranking of it; for it is cranked like a *Cockleshel* almost, which the *Muscleshel* of the sea is not, unless perhaps there be some such *Muscle* of the sea which I never saw. Again, the stone which I said was like the kernel of an *Almond*, I know not what fish or creature to liken it to, unless it be a Snag¹⁰ without shel (such as are in *Peason*,¹¹ and in Gardens at time of year) when his horns are drawn in, and his body is shrunk up; and yet it doth not so perfectly resemble that neither, because this is cranked on the side, and that is not, and yet further, those other little stones which I said were less then *Cockles*, with a lip turned up, are neither exactly like *Cockles*, nor any other Shel-fish that I have seen, but seem rather to be as natural stones, as Flints or Pebbles. But that which wil put the matter quite out of doubt, is, that the *Scallop* which I said was given me, and which I have now by me, and intend to preserve for the satisfaction of the curious, is most manifestly different from the true Shel-fish of the Name; for whereas the true *Scallop* hath one shel concave, and the other flat, both the pretended shels of this *Scallop-stone* are concave. So that unless there be a kind of *Scallop* which I never saw yet, this one stone is able to convince any man that these stones are not petrifications. Natural there is no doubt they are, and such as now they are from the Creation; but how they came to put on such strange and imitating figures, is a secret we dare not

meddle with, til we have satisfied Sir *Francis Bacons* mind, by writing a compleat History of *Nature* and *Art*. I onely forget to tel you, that all these stones are found near the surface of the *Earth*; and if you dig any depth, you will find no more of them¹²; and that they are also to be found upon the Hil between *Hilsley* and *Upton* (about a mile from *Alderley* Southward) in the horse-way." (p. 74.)

"At *Keinsham* in stone quarries, are found stones in the form of a Serpent, like the *Whitbay* stones (of which I shall speak more in *Yorkshire*) onely here is the difference between them; whereas those at *Whitbay* want heads, some of these have.¹³" (p. 33) [35].

"At *Lassington*¹⁴ a village about a mile and a halfe from *Gloucester* West or Northwest, on the side of a hill, a little below the brow of it, in the high way are to be found little Star-stones,¹⁵ the Greeks call them *Astroites*.¹⁶ They are thin (about the thickness of a halfe-Crown,) flat and five pointed like a Star or Mullet¹⁷ in Heraldry, onely the points of them are not sharp, but a little roundish, and most of them are not so big as a single halfe penny,¹⁸ though some are very near as big. Further they are of a grayish colour, and on both sides curiously graved (as it were by art with a fine graving instrument, & a neat hand) as if there were a little Mullet within the great. You shall find many of them joined together (flat side to flat side) in little Columnes, or Prismes an inch long or more, halfe a score or more of them together, and so fast, that you cannot sever them without breaking; though they are distinguished with a perfect line. I believe they were all knit together in such Columnes at first, (even those which are found single) and that they were severed by frost, or some such piercing cause. Being told of these Rarities so nigh me, I took a journey to see the place, and gathered many of the stones, and found them such as I have told you. Being put into Vinegar they have a motion, as other *Astroites* have, though not so lively; I suppose because of the shortness, and roundishness of their points, in the form of which I conceive lyes a great part of the cause of their motion. Some of these stones (like the stones at *Alderly*) are deficient in their figure, and have the defect supplied (or rather Super-supplied) with a rugged formless matter, hard like it self. I observed that the ground is a miry deep rotten Clay,¹⁹ and extream bad way in Winter, and (which I wondred most of all at) there were here and there great Pebbles as big as a mans fist, or thereabout, mingled with this rotten earth, and by enquiry I found that this mixture of Pebbles was not from any mending of the high way,

but the meer originall nature of the Earth, for I found these Pebbles in the fields as well as in the high ways. So that since this thwarts, what we said but now of Pebbles being the naturall companions of gravelly land, we are willing to grant, that (as in Gammar, so) in naturall Philosophy there is no general rule without an exception. Query, Whether in other places, where the Star-stones are found, as about *Shugbury* in *Warwickshire*, and *Belvoir* Castle in *Leicestershire*; the earth be so rotten, deep and miry, and withall whether there be any such great Pebbles mixed with it, as here, and in particular enquire²⁰

At *Purton* passage over the River of *Seavern*, when the shore as it is reported, yieldeth these Star-stones also, but they are bigger, and the Columnnes of them longer than at *Lassington*. And indeed accordingly it is delivered to me, as a miry ousy shore²¹ in some places, and a quicksand in others, very dangerous for horse and man at low water, and one of the worst passage, over the River at those times." (p. 81.)

NOTES

Figured stones (*lapides figurati* or *lapides idiomorphi*), as fossils were formerly called, exercised a strong fascination over the mediæval and renaissance mind which, failing to grasp their true nature and significance, invented fanciful theories to explain their existence and their resemblance to organic structures. A formative principle acting within the earth was postulated by some, others suggested the introduction into the rocks of living spores, and others again invoked the influence of the heavenly bodies, but one of the most widely accepted idea, and certainly the most persistent, was that fossils were inexplicable, capricious sports of nature. "Why," it was argued, "should not a stone take the same form as an animal or plant?" Yet these beliefs were forcibly challenged by astute observers, even in the 16th century, who insisted on an organic origin for fossils. Among these were Leonardo da Vinci (1452-1519), Hieronymus Fracastora (1483-1553) and Bernard Palissy (1510-1589). The views they expressed, at first treated as heretical, gained ground in the 17th century and became almost universally accepted before its close. Nevertheless, naturalists of the perspicacity of Martin Lister (1638-1711) and Edward Lhuyd (1660-1709) were unable to accept the newer conception and carried the older one beyond 1700. Among the few works published during the early decades of the 18th century which still treated fossils merely as "figured stones" is Nikolaus Lang's *Historia Lapidem Figuratorum Helvetiae*, Venice, 1708.

Childrey, writing in the third quarter of the 17th century, is conservative in his outlook, yet nevertheless is fully cognizant of the opinions then rapidly winning ascendancy. His arguments

against figured stones being petrifications are interesting. It is clear he was unable to distinguish between the shells and the matrix. In his day, the word 'fossil,' now narrowly restricted to organic remains or to evidences of organisms preserved in contemporaneous strata, had a somewhat different and a much wider implication. The term was applied to any stone, mineral, or mineral substance found in the earth (L. *fossilis*, something dug up). Also see F. D. Adams, 1938, *The Birth and Development of the Geological Sciences*, Baltimore, and K. A. von Zittel, 1901, *History of Geology and Palæontology* (Translation by M. M. Ogilvie Gordon), London.

- ¹ The limestone underlying Badminton Park and the village of Great Badminton is the Forest Marble. The cylindrical stones are belemnites.
- ² Alderley, one and a half miles South of Wotton-under-Edge, lies at the foot of the Cotteswold escarpment. The hamlet is built on Middle (arenaceous) and Upper (argillaceous) Lias and immediately below the outcrop of the Cotteswold Sands. The ground is thus correctly described as being "partly a sand and partly a clay."
- ³ Ammonites. From the account of the snake stone which Childrey gives a little further on, we are able to gather that the form was compressed, had a keel and that its ribs were sigmoidally curved. This description applies to several genera which are to be found in the vicinity of Alderley but, from his intimate knowledge of the neighbourhood, Mr. F. G. Hudson believes the ammonite to have been *Harpoceras falcifer* (pl 14, figs. 2 and 2a). He writes that the species is widespread on the ground just above the marlstone (Middle Lias), and the clays in which it occurs can be traced all along the foot of the escarpment from Sodbury to Stinchcombe and beyond. He adds that he has seen the ammonite lying in countless profusion on the Dursley Housing Estate when excavation preliminary to building was in progress.
- ⁴ These remarks refer to the Authorised Version of 1611, printed by Robert Barker. In this Bible, ornamental genealogical tables precede the Book of Genesis, and a shield displaying a coiled snake symbolizes the Tribe of Dan, in allusion to Gen. xlix, 17, "Dan shall be a serpent by the way, an adder in the path. . . ." The device (pl. 14, fig. 4) remotely recalls an ammonite but the coils are not in contact and naturally the reptile has a head, but it may be remembered that the three ammonites which form the arms of Whitby are also given heads, in keeping with the old belief (still lingering) that these cephalopod shells are serpents miraculously turned to stone.
- ⁵ *Pecten* (*Æquipecten*) *æquivalvis*. There can be very little doubt that the scallop mentioned here is the large common Middle Lias species. *P. æquivalvis* considerably exceeds in size the

living *P. maximus* and has two convex valves (concave if their interior is described).

- ⁶ Probably *Modiola*.
- ⁷ The stones which Childrey compares to kernels of almonds may have been either lamellibranchs or brachiopods: more than this it is not possible to say.
- ⁸ The 'little stones' of approximately the size of a hazel nut almost certainly included species of *Rhynchonella*. These little stones, we are told, are cranked (ribbed) like a cockle shell but their margin differs from that of the cockle in being folded in the manner of a hanging lip (blobber lip). How well this quaint description tallies with *Rhynchonella* can be judged from the drawing of *R. tetrahedra* from the Middle Lias (pl. 14 fig. 5). But the fossils, it is mentioned, varied one from another in detail and were collected over a wide area, and some from other parts of the country, so that it is certain that they were found at different horizons and included several species not necessarily all of *Rhynchonella* and perhaps not all brachiopods.
- ⁹ The skale no doubt is the actual thin ammonite shell.
- ¹⁰ Snail or, as in this case, a slug.
- ¹¹ Peason is a variant of 'pesen' or 'peasen,' plural, of 'pease,' old form of 'pea.'
- ¹² Childrey is speaking of the subsoil, and what he says, although not strictly correct, is in some measure true. Fossils and rock fragments tend to work upwards towards the surface as explained in note II³. Had our author searched a little more thoroughly he would have found that the subsoil was not entirely destitute of "figured stones."
- ¹³ The commonest ammonites at Keynsham (Lower Lias) are species of *Coroniceras* (pl. 14, figs. 3 and 3a). Many of these attain considerable dimensions; specimens often measure 45 centimeters and more in diameter. Childrey no doubt gathered the impression that some of these possessed heads, through a fanciful resemblance to a head which weathered matrix (possibly in combination with sutures) may well have conveyed to one looking for a more or less perfect replica of a coiled serpent. Elsewhere (see under ammonites from Alderley) he expresses doubts as to whether ammonites ever have heads.
- ¹⁴ The village of Lassington stands on Lower Lias.
- ¹⁵ Isolated ossicles of *Pentacrinus* (*Extracrinus*). The species of this crinoid are characterised by the quinquerradial symmetry of their stem, but the stem section varies in different species from the simple pentagon to star-shaped. Representative ossicles and columns of *Pentacrinus* figured by Nikolaus Lang, 1708, are reproduced on pl. 14, fig. 6. The drawings, although perhaps a trifle crude, are remarkably exact.

- ¹⁶ It is extremely unlikely that the stellate crinoid ossicle was known to the Greeks and it is even uncertain whether the word *αστροιτης* was used by any Hellenic writer. If so, it signified a particular gem, as *astroites* does in Pliny (*Natural History*, xxxvii, 133). In Pre-Linnaean literature, "*Astroites*" usually connotes a fossil coral.
- ¹⁷ The "star stone" certainly suggests the heraldic mullet or five rayed star, but it is not, as I have seen it stated, the origin of the symbol. The mullet is the conventionalized representation of the rowel of a spur.
- ¹⁸ These remarks refer to the hammered silver money of the period. The half-crown was about one millimetre in thickness, and the half-penny slightly under one centimetre in diameter.
- ¹⁹ Childrey believed that the star stones were actually generated in the clay.
- ²⁰ Paragraph obviously incomplete.
- ²¹ The Lower Lias, in which the *Pentacrinus* ossicles are found, outcrops east of Purton, whereas Purton Passage lies to the west of the village. The shore there owes its "miry ousy" character to the river deposits and not to the Lias.

IV. HOT SPRINGS, COAL SEAMS, ETC.

The thermal waters of Bath and Bristol very naturally come under the author's purview. For the details he gives of the four baths at Bath (the "King's," the "Queen's," the "Cross" and the "Hot" Bath) he is indebted to Thomas Johnson, 1634, *Mercurius Botannicus et Thermais Botanicis*. He tells the following story of how the citizens of Bath gilded silver coins:—

"The Minerals that are conceived by learned Writers to give these Waters their heat and Tincture, are *Bitumen*, *Sulphur*, and *Nitre*; and there is *Bitumen*, *Sulphur* and *Nitre* being in less quantity: The Mineralness of these Waters appears also by a way that the people of *Bath* have to give Silver Money a Golden colour, which is done with a Compsition made (as they say) of the mud of the *Bath*, and some of the *Bath*-Water and Urine mixed together, with which composition they rub the Money which they intend to gild; but the colour is but pale and faint, and will quickly wear off." (p. 33.)

Most of the space devoted to hot springs is, however, occupied in discussing the cause of the high temperature of the water. He first attributes this to the presence of coal in Somerset and South Gloucester, but later on, ignoring what he has already written, makes other suggestions, and published a letter on the subject. His remarks

on the coal of districts are, therefore, in order to obviate repetition, quoted here in the original setting and not under "Rocks," to which section they more correctly belong.

"Now that it is a *Bituminous* and *Sulphury* matter that gives this Water its heat and tincture; besides its Medicinal Vertues, as that it dryes, heats, dissolves, softens, opens, attracts, digests, cuts, and is abstersive &c, there is this manifest proof, that the Countrey hereabouts is full of Cole-Mines,¹ especially about *Bristol*, and the southenmost parts of *Glocestershire*, as *Mengerfield*, *Westerley*, &c. and so also under *Mendip-Hills*, that part of them that lyes towards *Frome-Selwood*. And all *Naturallists* agree (as they have reason) that *Coale* is a *Bituminous* and *sulphury* matter; For that it is a *Bitumen*, is manifest by its black pitchy viscosity, and its melting as it burns: And that there is a quantity of *Sulphur* in it, is as evident by the Brimstony smell the Embers of them give, as any one may find that will but hold his head a while over a pan of them; as also by their burning blew many times, especially when they burn eagerly, as in frosty Weather; whence many people reckon the fires burning blew, a signe of frost and hard weather. And (which is yet a further argument, the Coale hereabouts hath abundance of Veins like Gold or Brass² in it (as I have often observed my self, and it may be observed every day; for indeed there is nothing more common) a thing which I could never observe in *New-Castle* Coal, though this Cake as that doth, and doth not burn all away to a white ashes, as the Coale which they dig about *Staffordshire*, and which I think they call *Canell-Coale*.

There are (saith *Cambden*) a kind of pit-coals digged near the River *Frome*, with which *Smiths* use to soften Iron. These are the Coales I mentioned before, under *Mendip Hills*, toward *Frome-Selwood*: That they should soften Iron, is no wonder, since we see any Coal, or the like violent fire doth the same; but whether they have a singular power thatway above other coal, may be further enquired." (p. 33.)

"There is about a mile Eastward from *Bath*, a great hill, and on the top of it a very large barren Plain, called *Landsdown*, under which very probably, if search were made, would be found the Mineral or Furnace that heats the *Bath-Water*; but no doubt it lies so deep, that it would not be worth the time, the pains, or the cost to search after it; it seems by the very sight of it to be pregnant of some such matter. *These were my thoughts at first, touching the Bed of the Minerall that heats*

*the Bath ; but Dr. Meara of Bristow hath since taught me to lay down that conjecture, by shewing me the Copy of a Letter written by himself in Latine to Dr. Prujean of London, touching astrange thing that happened in July 1659, at the Bath ; the abstract of which I shall take the boldness to give the reader in the Doctors own words, as followeth.** (p. 37) [39].

BATH, AUGUST THE 2d 1659

To the Worshipful his very much honored friend *Fran. Prujean D. of Physick, &c.*

W. and H. Sir,

What I should have done long since, &c. The Sacrifice I bring to your Altar, will not I conceive be ungratefull. It is the strange accidentall discovery of a noble Mistery touching the cause of the heat of the Baths here ; the search into which hath long exercised the most famous Physicians, the manner of it was thus. The right Honourable the Lord Fairfax, who continues still at the Bath with his Lady, riding abroad not far from this City two days ago, to take the air, by chance found a kind of Chalke³ as white as snow, working here and there out of the ground in little heaps, like earth cast up by Moles. A piece of this he brought home, and shewed me. It is a crumbling matter, and almost of its self turns to a small light dust : its tast is manifestly acide without astriction, but by little and little biting, and causing an extream hot strangulation in the mouth, so that I am perswaded it hath much Chalcanthus⁴ in it, and is not altogether without Arsenick. I put it into cold water, and presently it fell a boiling, and bubbling apace, just as if it had been quick Lime ; and by degrees the water grew so very hot that it would quickly have boiled an Egge. Now seeing that this Chalk is found near the Bath, I concieve it not unlikely that it is this, that heats the Bath-water, I know very well that Authors generally attribute the heat of Baths to Sulphur or Bitumen. Nevertheless, though it cannot be denyed that there is a great quantity of Bitumen and Sulphur found in these Springs, and the cure of Scabbiness, Ulcers, Trembling, the Palsey, and the like diseases doth evince that the Baths are plentifully impregnated with them ; yet I doubt whether either of them hath any thing of a fermentative power in them to heat water, seeing both of them want acidity, the efficient cause of fermentation ; and neither of them being put into water can produce any fermentation or heat. And since their consistence is clammy and viscid (especially that of Bitumen) that water cannot readily insinuate it self into the minute particles of them,

* Childrey reproduces the letter in both Latin and English.

they must needs be unfit for any such fermentation; The contrary of which will follow upon the crumbling and incoherent consistence of this Chalk. The place where this Fossile was found, is an earth porous like a sponge, so that it plainly appears to be (as it were) the flos, or excrescence of fermenting Minerall, working up out of the Earth with those Spirits, that cause the fermentation. But what to determine, and say positively in this dark riddle, I know not; and therefore humbly submit it to your judgement; returning you most cordial thanks, &c.

W. and H. Sir,

Your most obliged
servant *Ed. Meara.*"

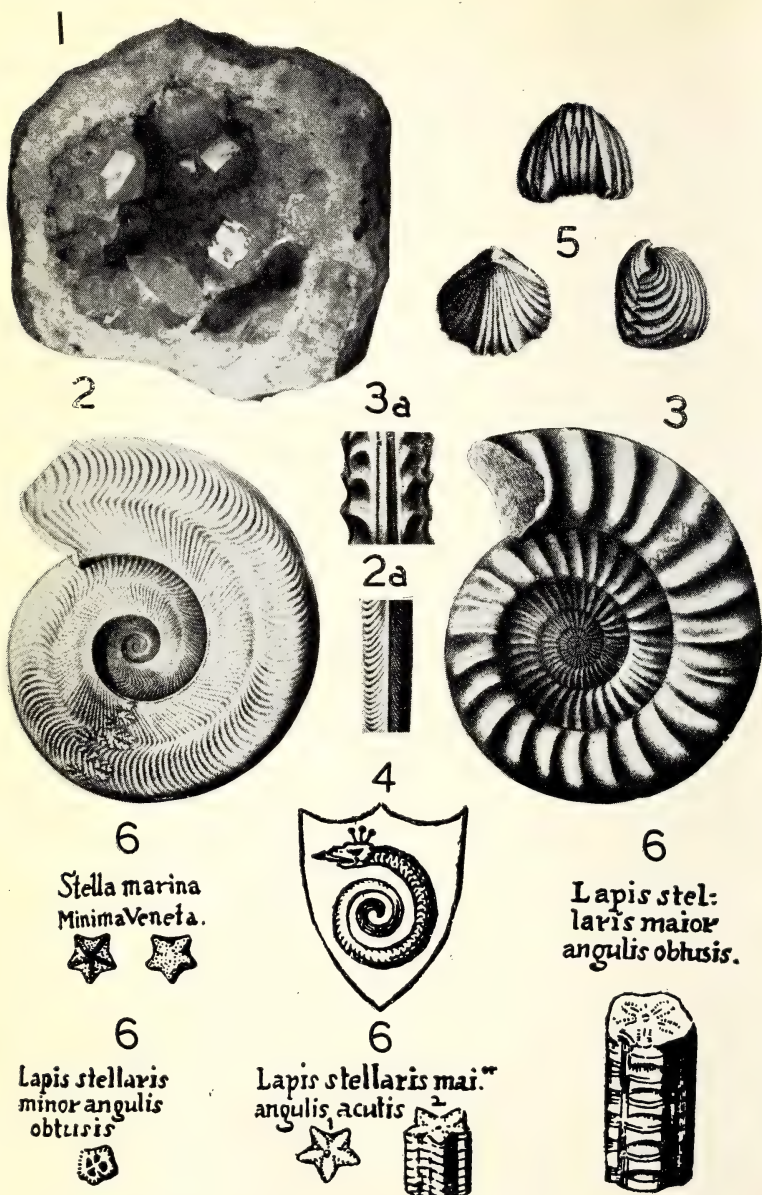
(p. 40) [42].

Concerning the warm spring at Hotwells, Clifton, he writes

"Not far from *Bristol* is the famous Rock called *St. Vincents Rocks*, ragged, and hanging over the bank of the River of *Avon*, where (saith *Johnson*) is a Well of warm Water, pleasing to the tast. It flows out of the Cleft of a great Rock, & is overflowed every Tide, and left open to the air at the ebb⁵; for its spring breaks out at the Root of the Rocks; the Water is much commended for *Ulcers*, and calculous affections of the reins, being taken inwardly, It is also often applied outwardly to cure old sores with very good success (saith he) as I have heard those say that have tried. There is moreover in this place a Vein of Iron in the Bowels of the Earth⁶ (saith the same Author) whence the water gets it vertue, and a greater heat, which it loseth by running a great way before it can get out. But by my Authors leave, it cannot be conceived how a vein of Iron should make water so hot, since we see that iron Mines in other places work no such effect upon those Waters that run through them. I rather conceive there it is some other Vein of Metal, or rather Mineral there, that is the cause of the heat, and likely the same Mineral that causeth the heat of the *Bath-Waters*. Much more I could say, but I am unwilling to enlarge too far upon Plausibilities. Note that this hot Well is not above 12, miles from *Bath*." (p. 36.)

NOTES

The water of the Bath Springs owes its high temperature (120° F. = 55° C.), salinity and radio-active content to its deep seated origin. Its source is the highly disturbed, much shattered Palæozoic rocks which underlie at no great depth (200 ft. or so) the approximately horizontal Mesozoic strata. The water, no doubt, finds its way to the surface along lines of fracture produced



by posthumous movement along ancient fault lines. The subject is discussed at some length by R. H. Rastall, 1924, in the *Geological Magazine*, Vol. XLIII, p. 98 *et seq.* Thus Childrey arrived very near the truth in his surmise that "the furnace" which heated the Bath water lies so deep that it would not be worth the time, labour or cost of searching for it—very much nearer so in fact than was his friend Dr. Meara.

¹ Although one may smile at Childrey's naïve suggestion that the thermal springs at Bath owe their high temperature to the coal seams in the neighbourhood, nevertheless an interesting archæological link connects the two. We are informed by Caius Julius Solinus, a third century writer, that there was in the temple of Sulis—the deity who presided over the hot springs—a perpetual fire which never whitened into ash but, as it died down, turned into rocky lumps. This statement has reasonably been interpreted as implying that the sacred fire was fed by mineral coal, and points to coal mining in the district in Roman time.

² Films of pyrite are to be seen on joint-faces in most coals, and those from the North offer no exception in spite of Childrey's assertion that he had never observed veins of gold or brass in Newcastle coal.

³ This 'Chalke' may actually have been calcareous subsoil brought to the surface by moles, in which case no explanation can be offered for Meara's statement that it raised the temperature of cold water; on the other hand, however, as Mr. H. W. Turner has suggested, it may well have been caustic lime which had been placed there by agriculturists for soil dressing.

⁴ Hydrous cupric sulphate.

⁵ This statement is quite correct.

⁶ Veins of haematite are frequent in the Carboniferous Limestone.

I owe the opportunity of publishing these extracts to Dr. John Pringle who, some little time ago, presented me with a copy of the *Britannia Baconica*. For this most acceptable gift I tender him my warmest thanks. I also thank all those with whom, verbally or by letter, I have discussed various matters arising out of Childrey's statements, the Editor and printers of these *Proceedings* for the care they have taken in reproducing this paper, and the Bristol University Colston Society for defraying in part the expenses of publication.

EXPLANATION OF PLATE 14

Fig. 1. Potato-stone containing 'Bristol diamonds' (quartz crystals). Slightly reduced. p. 411.

- Fig. 2. *Harpoceras falcifer*. The Alderley snake stone. Much reduced. After Wright. p. 419.
- Fig. 2a. The same, part of venter.
- Fig. 3. *Coroniceras bucklandi*. The Keynsham snake stone. Much reduced. After Wright. p. 420.
- Fig. 3a. The same, part of venter. In both ammonites the venter shows a keel—the ‘*spina*’ of Childrey.
- Fig. 4. ‘Banner of Dan,’ from the Bible of 1611. A little enlarged. p. 414.
- Fig. 5. *Rhynchonella tetrahedra*. ‘Stone cranked like a cockle-shell but bent up in the fashion almost of a blobber-lip.’ Approximately natural size. After Davidson. p. 420.
- Fig. 6. *Pentacrinus* ossicles and columns. Approximately natural size. After Nikolaus Lang. p. 420.

The Vegetation of Berrow, North Somerset

By GERTRUDE M. BOLEY

1. THE SALT-MARSH COMMUNITY

(Received, March 9, 1943)

I. INTRODUCTION

THE vegetation of the coastal region at Berrow, near Burnham-on-Sea, includes three plant communities:—

1. The salt-marsh community of the intertidal zone, on a substratum of marine alluvium.
2. The fore-shore community on the strand, which borders the mud-flats and is barely reached by the highest tides.
3. The sand-dune community on the coastal sand-dunes, merging into dune-pasture-land. In this area fixed dunes have been artificially drained and converted into golf links. In the sand dunes there are both open and closed communities with characteristic vegetation.

The progressive changes in the phanerogamic vegetation of this region have been observed and recorded by the late H. S. Thompson (1922, 1930). Further observations, illustrated by a map of the salt-marsh, are recorded in a more recent publication by O. D. Kendall (1938). Annual visits, for the purpose of ecological study, have been made by students of Bristol University under the direction of the late Dr. Rose Bracher since 1926, and records have been kept. It has been suggested that the present state of the vegetation should be described and a comparison made with the earlier observations, and in the present paper this is done for the salt-marsh community.

II. PREVIOUS RECORDS

In 1922 H. S. Thompson emphasized the changed aspect of the mud-flats S.W. of Berrow Church as previously free from vegetation and locally known as the "Low Lighthouse Marsh." He published a map illustrating the region and described the marsh as "a large area of dark green vegetation covering approximately 100 acres, adjoining hard sand, stretching seaward for 1,500 yds., from 400 yds. north of the

VEGETATION MAP OF LOWER LIGHTHOUSE MARSH, BERROW 1942.

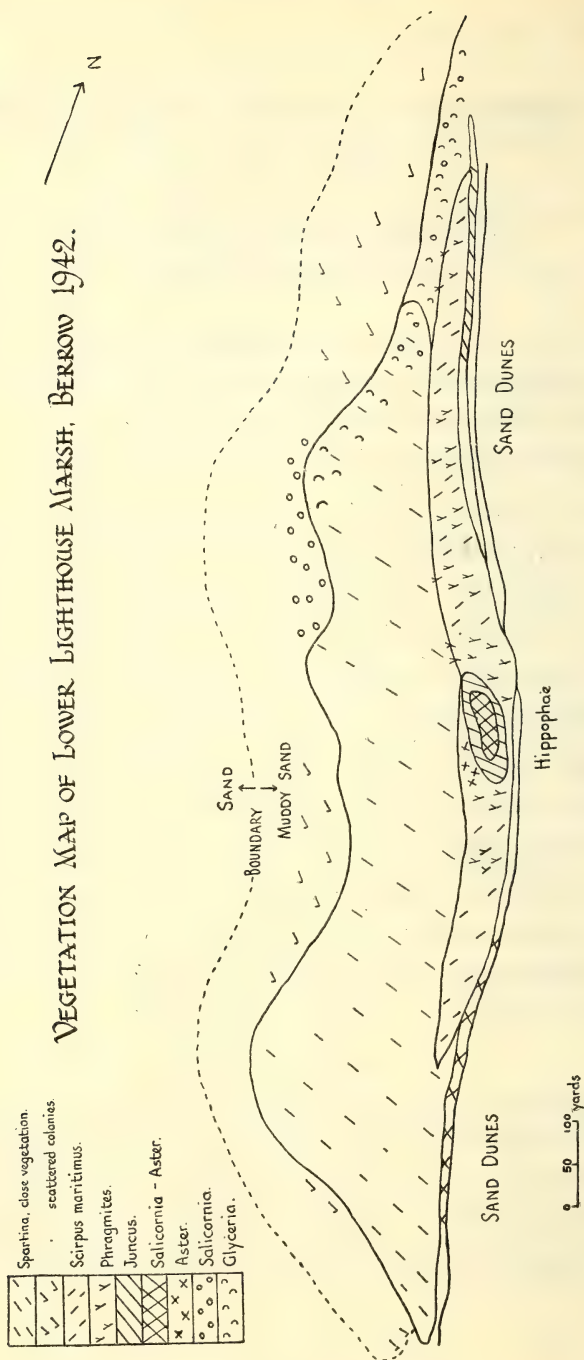


FIG. 9

Low Lighthouse to 600 yds. south-west of Berrow Church and tapering at both ends." He estimated its greatest width at 400 yds. and dated its inception at 1910. His opinion was that it owed its origin to a new tributary channel 10 ft. deep and 40 ft. wide entering the river Parrett 600 yds. west of the Lighthouse. "The Channel," he wrote, "draining a portion of the muddy Berrow Flats may be the cause of the new vegetation by diminishing the force of scour over the flats between it and the sand-dunes." At this period the marsh was occupied by a *Salicornia-Glycerietum*.

By 1923 Thompson noted that the mile-long channel had become silted up and that its northern end had disappeared. In 1929 he again surveyed the area and found that it had lost 300 yds. at its southern end and gained 100 yds. at its northern extremity. It now extended 1,100 yds. along the shore and had a greatest width of 300 yds. and a very irregular lower margin. Of the vegetation he wrote, "The marsh has now become a conspicuous feature of the landscape. Dense masses of *Scirpus maritimus* now form an interrupted broad belt occupying the landward border. Beyond this a wider and very thick belt of *Aster Tripolium* is ousting the *Glyceria* beneath it, whilst on the seaward or western area *Spartina Townsendi* has become dominant and *Glyceria* remains only in dwarf patches. These three belts or zones of vegetation can be observed from the adjacent sand-hills." An important feature mentioned was the occurrence of a number of non-halophytic species especially in the wettest part of the marsh. Lists of the plants recorded are given along with those found in 1942 in Table I.

From Thompson's descriptions and records it is clear that by the year 1930 three stages in the salt-marsh succession or halosere could be observed in the vegetation of the marsh:

1. The rapid colonisation by *Spartina Townsendi* of the deepest mud of the western area, restricting the occurrence of *Salicornia* and *Glyceria*.
2. The development of the *Asterietum*.
3. The inception of a belt of *Scirpus maritimus* and the appearance of non-halophytic species.

In the course of a survey of the Somerset coast, O. D. Kendall (1937, 1938) observed that the marsh had lost ground at its northern extremity and that it had shrunk in size very considerably. From a

TABLE I
PLANTS RECORDED FROM THE MARSH IN 1922, 1930 AND 1942

	1922	1930	1942
<i>Agropyron junceum</i> Beauv. ..	—	—	L.A.
<i>pungens</i> R. & S. ..	—	—	O.
<i>Agrostis alba</i> L. ..	—	+	O.
* <i>Alisma Plantago-aquatica</i> L. ..	—	+	O.
* <i>Apium graveolens</i> L. ..	—	—	F.
* <i>nodiflorum</i> Reichb. ..	—	—	F.
<i>Aster Tripolium</i> L. ..	O.	L.D.	L.A.
<i>Atriplex portulacoides</i> L. ..	—	—	F.
<i>Carex distans</i> L. ..	—	—	L.A.
<i>extensa</i> Good. ..	—	—	O.
<i>flava</i> L. ..	—	—	O.
<i>vulpina</i> L. ..	—	+	L.A.
<i>Festuca rubra</i> L. ..	—	—	L.A.
<i>Glaux maritima</i> L. ..	—	L.A.	L.A.
<i>Glyceria maritima</i> M. & K. ..	D.	L.A.	L.A.
<i>Hippophae rhamnoides</i> L. ..	—	—	O.
* <i>Iris Pseudacorus</i> L. ..	—	—	L.A.
<i>Juncus acutiflorus</i> Hoffm. ..	—	+	—
<i>articulatus</i> L. ..	—	+	F.
* <i>bufonius</i> L. ..	—	—	L.A.
<i>communis</i> Mey. ..	—	—	O.
<i>effusus</i> L. ..	—	—	F.
<i>Gerardi</i> Lois. ..	—	L.A.	L.A.
<i>glaucus</i> Ehrh. ..	—	+	O.
<i>maritimus</i> Lam. ..	—	—	O.
<i>Lepturus filiformis</i> Trin. ..	—	—	L.A.
<i>Lycopus europaeus</i> L. ..	—	—	O.
<i>Melilotus officinalis</i> Lam. ..	—	—	R.
* <i>Oenanthe pimpinelloides</i> L. ..	—	—	L.A.
* <i>Phragmites communis</i> Trin. ..	—	—	—
<i>Plantago major</i> L. ..	—	—	L.A.
<i>Coronopus</i> L. ..	—	—	L.A.
<i>Potentilla Anserina</i> L. ..	—	—	L.A.
<i>Rumex</i> spp. ..	—	+	O.
<i>Salicornia dolichostachya</i> Moss ..	D.	O.	—
<i>europaea</i> L. ..	O.	R.	L.A.
<i>appressa</i> Dum. ..	—	—	L.A.
<i>ramosissima</i> Woods ..	O.	—	L.A.
<i>Smithiana</i> Moss ..	R.	—	—
<i>Salix</i> sp. ..	—	—	R.
<i>Scirpus maritimus</i> L. ..	—	L.D.	L.S.D.
<i>Tabernaemontani</i> Gmel. ..	—	R.	—
<i>Spartina Townsendi</i> H. & J.G. ..	R.	L.D.	L.D.
<i>Spergularia marginata</i> Kit. ..	R.	O.	F.
<i>Suaeda maritima</i> Dum. ..	R.	O.	O.
<i>Trifolium fragiferum</i> L. ..	—	—	L.A.
<i>Triglochin maritimum</i> L. ..	—	—	F.
<i>palustre</i> L. ..	—	R.	R.
<i>Typha latifolia</i> L. ..	—	F.	L.S.D.

O., occasional : D., dominant : S.D., sub-dominant : L.D., locally dominant : F., frequent : L.A., locally abundant : R., rare.

Plants marked * are typical fresh-water aquatics or sub-aquatics.

traverse carried out by chain and plane-table he gives the following measurements :

1937 .. length, 1,280 yds. width, 200 yds.

1938 1,250 240 ..

The area, calculated by planimeter, was 44 acres. "The vegetation," wrote Kendall, "is exceedingly dense, a very striking feature of which is the predominance of *Spartina Townsendi*."

III. THE VEGETATION IN 1942

The area was visited in July and again in October, 1942. Herbarium specimens were collected and lists of species made. With the help of a small band of workers, some measurements were made and a base line was run out along the lower edge of the strand. From these it appeared that along the shore the marsh had again gained ground. Its length was 1,550 yds. from the southern end to the tapering end of its northern extremity. Along its western border, which seems to fall below the level of Gore Sands, the marsh is intercepted by narrow creeks and fringed with sandy hummocks of varying size. Beyond this, seaward, degeneration of the vegetation as well as colonisation can be observed.

On the marsh itself the distribution of plants is clearly defined and there are three natural zones of vegetation :

1. *Salicorno-Glycerietum*.
2. *Spartinetum Townsendi*.
3. *Scirpetum maritimi*.

1. *Salicorno-Glycerietum*. This pioneer community, dominant in 1923, has had a fluctuating history. It is now confined almost entirely to the north-west edge along the lower reaches of the marsh, where the creeks are most stable and there are shallow pools. In this area there is a pure *Salicornietum* on an open stretch of mobile mud with an area of approximately 2,050 sq. yds. The plants are vigorous, although many show the force of the tides in the distortion of their axes. The species present include *Salicornia europæa*, *S. ramosissima* and *S. prostrata*, var. *appressa*.

Glyceria maritima dominates the low sandy hummocks and ridges which have accumulated along the upper margin of the mobile mud. North-east of these, *Salicorno-Glycerietum* occurs as isolated patches along the seaward edge of the *Spartina* belt. This community is frequently invaded by *Agropyron junceum* on the sandy elevations.

On the more muddy depressions between these elevations, *Suaeda maritima*, *Aster Tripolium* and *Atriplex portulacoides* occur occasionally.

2. *Spartinetum*. This community, covering many acres of deep mobile mud, constitutes the widest belt of vegetation and is the most characteristic feature of the marsh. The dominant plant, *Spartina Townsendi*, is first seen as a single colony at the foot of the Low Lighthouse. It occurs again very sparsely 400 yds. to the north and then gradually closes in to a dense mass of vegetation which fringes the western side of the salt-water pool on the edge of the strand and pushes out seaward. The rapidity and vigour of the growth and spread of this plant are remarkable, but evidence is lacking as to its origin. Thompson suggested that it may have originated from Cord-grass planted by a local farmer at Clevedon in 1913; pieces of the rhizome may have been carried down by the tide and round the promontories of Sand-Point, Birnbeck and Brean Down and have been washed up on the muddy Gore Sands. However this may be, on July 9, 1921, this close observer noticed "three large clumps—two of them more than 9 ft. across—and well established on the mud." From these plants the present broad and dense mass of *Spartina* has developed and it continues to colonise successfully the deepest mud.

Traces of the *Asteretum* mentioned by Thompson may be seen in scattered patches along the upper margin of this zone; but its individuality has been lost between the belts of *Spartina* and *Scirpus*.

3. *Scirpetum maritimi*. The vegetation of this zone is varied and complex. It includes both fresh-water aquatics and land plants. The dominant *Scirpus maritimus* invades the *Spartina* zone 300 yds. from the southern end of the marsh. From this point the *Scirpetum* widens to form a belt approximately 50 to 80 yds. wide, which extends along the eastern side of the marsh for 1,050 yds. *Typha* is locally sub-dominant and the community is invaded by colonies of *Phragmites*, a few of which are closely united to the land. Other fresh-water species are less common.

South of one of the colonies just mentioned the continuity of the belt is disturbed by a patch of muddy sand, 140 yds. long by 38 yds. wide, which supports an *Astero-Salicornietum* surrounded by rushes (dominant species *Juncus Gerardi*) and a colony of *Trifolium fragiferum*. In this small area *Glyceria maritima* and *Festuca rubra* are abundant while *Plantago coronopus*, *Triglochin maritimum*, *Glaux maritima* and *Spergularia marginata* also occur but are less frequent. It is along the

margin of this zone that the greatest variety of plants is found. Various non-halophytes form pasture societies, and seedlings of *Hippophae rhamnoides* and Willow saplings mark the beginning of scrub.

4. *An open community.* North of the Scirpetum the vegetation gradually opens out and the communities lose their individuality. *Spartina* is still a vigorous colonist and *Glyceria* continues to dominate mounds and ridges of sand and mud. As the marsh tapers to its end the plants become more sparsely distributed until only a few very small isolated patches of *Glyceria* are to be found on the sand. On this open area *Glaux maritima* and *Juncus bufonius* are very abundant. Other species include *Aster Tripolium*, *Juncus Gerardi*, *Carex extensa*, *Spergularia marginata*, *Triglochin maritimum* and *Salicornia* spp.

IV. CONCLUSION

From this comparative account it may be seen that the Berrow vegetation has, since the beginning of colonisation, shown the usual stages in the development of a salt-marsh community; and, further, that these various stages may all be seen on the marsh at the present time.

The factors involved in the various changes noted have not been studied in detail, but it is safe to assume that changes in drainage and silting leading to altered levels and salinity have been most important.

I wish to thank Miss Joan Fraymouth and Miss Audrey Jones for assistance in surveying the marsh, and Prof. M. Skene for help in the preparation of the manuscript.

I have also to acknowledge assistance by a grant from the Colston Research Society.

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Geology of a Recent Borehole at Filton, Glos.

By W. F. WHITTARD, Ph.D., D.Sc., F.G.S., and
STANLEY SMITH, M.A., D.Sc., F.G.S.

(Received, March 19, 1943)

A DEEP borehole for water has recently been sunk within the property of the Bristol Aeroplane Company at a position 350 feet W 22° N of Fairlawn House; the ground was entered 249 feet above Ordnance Datum. A dump well 6 feet deep was first dug and the borehole driven to a depth of 129 feet by means of percussion boring; rotary drilling was then commenced and continued to a depth of 694 feet. The borehole was lined to a depth of 30 feet with 18" diameter tubes, to 246 feet with 15" tubes, to 395 feet with 12" tubes, and the remaining interval to 694 feet with 10" tubes. The yield of water is 7,800 gallons per hour. The rest level is 132 feet 3 inches above, and the pumping level 96 feet below, Ordnance Datum.

The geological records down to 129 feet were necessarily incomplete, as rock specimens were obtained from between the chisels only when the boring bit was hauled to the surface. The horizons tabulated below were recognised but the thickness of the Cotham Beds may be too small and that of the Lower Lias correspondingly too large. Fragments of Lower Liassic limestone were recovered from a depth of 55 feet and these could have worked their way down the hole from the higher level; if the Cotham Beds are in fact thicker than indicated in the table, then they presumably broke down to a sludge and their identity was masked by the similarly coloured sludge produced by the Lower Liassic rocks. The minimum thickness of 13 feet for the Rhætic beds compares favourably with 17 feet 4 inches determined between Brentry Farm Cottage and Pen Park Road, Southmead (Kellaway, 1931, pp. 291-2).

	Interval in feet.	Depth in feet.
Clays and thin limestones of the Lower Lias. No fossils found	55	55
Pale grey shales which resemble the Cotham Shales; no trace of the Cotham Marble	3	58
Black Westbury Shales with ' <i>Schizodus ewaldi</i> Born; no trace of the Rhætic Bone Bed	10	68

	Interval in feet.	Depth in feet.
Pale greenish-grey, hard, calcareous marl similar to hard bands in the Tea Green Marls	2	70
Pale greenish-grey shales with small fragments of calcareous marl; the latter may have fallen from above or they may indicate thin calcareous marls interbedded in the shales ..	16	86
Red marls with thin layers rich in gritty material.	43	129

Rotary drilling was commenced at a depth of 129 feet and the record is almost complete over a length of 565 feet, the few instances when a core was not recovered being of minor importance.

	Thick- ness. ft. ins.	Total Depth. ft. ins.
Red marl with thin bands of green marl and micaceous marly sandstone; thin bands, veins and nodules of brownish-red alabaster	11 0	140 0
Red marl with thin bands of green marl and micaceous marly sandstone; no alabaster. A three-inch band of red marl carrying innumerable minute rhombs of dolomite occurred at 162 feet	23 0	163 0
Band of crystalline gypsum	6	163 6
Red marl becoming darker in colour towards the base due to increased ferruginous content, and showing occasional small quartz pebbles and numerous nodules of limonite up to $\frac{1}{4}$ inch in diameter. There is no development of the Dolomitic Conglomerate	5 0	168 6
Carboniferous Limestone traversed by joints and fissures sometimes filled by Triassic marl and at other times carrying dog-tooth calcite and fibrous gypsum. The junction between the Trias and the Carboniferous Limestone appears to be almost horizontal	1 6	170 0
Grey and pink, compact, oolitic limestone, with large crinoid ossicles. <i>Lithostrotion junceum</i> (Fleming) occurred at 170 feet, a large colony of <i>Nemistium edmondsi</i> , Smith, in which the corallites were dolomitised, at 173 feet, and <i>Dibunophyllum bristolense</i> , Garwood and Goodyear at 176 feet ..	16 0	186 0
Maroon shale and pale, greenish-grey, earthy limestone interbedded with thin bands of red crystalline limestone. The beds are badly disturbed, being brecciated, slickensided and veined throughout with calcite	4 0	190 0
Maroon and greenish-grey, mottled, calcareous shales which yielded at the top a rhomboidal fish scale	2 0	192 0
Reddish-brown, finely oolitic limestone with <i>Productus</i> (?) <i>productus</i> (Martin), <i>Athyris planosulcata</i> , Phillips, <i>Phricidothyris</i> cf. <i>lineata</i> (Martin) and <i>Spirifer wickensis</i> , Vaughan ..	1 9	193 9
Maroon and greenish-grey, mottled shale with thin earthy limestone	2 3	196 0
Grey, close-grained, arenaceous limestone stained pink ..	4 0	200 0
Maroon and greenish-grey, mottled shale	1 0	201 0
Grey, oolitic limestone	6	201 6
Core broken down in hole	4 6	206 0

	Thick- ness. ft. ins.	Total Depth. ft. ins.
Pink, subcrystalline, arenaceous limestone with drusy cavities and <i>Lithostrotion junceum</i> in position of growth; other corals include <i>Nemistium edmondsi</i> , <i>Lonsdaleia floriformis crassiconus</i> (McCoy), ' <i>Diphyphyllum</i> ' <i>lateseptatum</i> (McCoy) and <i>Dibunophyllum</i> sp.	2 0	208 0
Brecciated, silty, oolitic limestone which has been converted into a dolomite-rich rock; the matrix has taken the dolomitization while the oolites have suffered complete solution and are now almost entirely represented by hollow spheres. <i>Lithostrotion</i> cf. <i>junceum</i> and <i>Orthotetes</i> (<i>Schellwienella</i>) cf. <i>crenistria</i> (Phillips) have also been dolomitized	6	208 6
Rotten limestone riddled throughout with calcite	1 6	210 0
Grey limestone with a high percentage of crystalline calcite and also blebs of galena	6	210 6
Fault-breccia consisting of rotten limestone and veined with calcite, dolomite, quartz, siderite, limonite and yellow and red ochre. One large block of limestone showing white oolites on a pinkish-grey background was present in the core	1 6	212 0
Limonite and quartz rock	6	212 6
Fault-breccia rich in limonite, and noticeably so when compared with above-mentioned breccia; followed downwards the content of iron-ore and quartz increases; veins of calcite also developed	5 6	218 0
Maroon shale, badly slickensided	4 0	222 0
Brick-coloured, blocky-weathering shale with quartz grains of silt grade and many oolites. The oolites are from 1 to 5 mm. in diameter, concentrically banded, and composed of argillaceous matter and hydrated ferric oxide*. Occasionally there are small pebbles of quartz showing a resinous lustre	8 0	230 0
Red, close-grained sandstone with irregular courses of pebbly grit	1 0	231 0
Uncored; rock ground away yielding a loose sand	32 0	263 0
Brick-coloured, blocky-weathering shale with quartz grains of silt grade and many concentrically banded oolites made of argillaceous matter and hydrated ferric oxide	7 6	270 6
Red marl with many sand grains	2 6	273 0
Pink, coarse-grained, calcareous sandstone with abundant oolites	2 0	275 0
Pink conglomerate containing milky quartz pebbles and abundant oolites	3 0	278 0
Pink, oolitic limestone with sand grains and a few quartz pebbles towards the base	1 0	279 0
Fine-grained, maroon, arenaceous limestone	2 6	281 6
Liver-coloured, micaceous shale	3	281 9
Liver-coloured, fine-grained, crinoidal limestone with brick-red oolites and faecal pellets; the fauna includes <i>Pugnax pugnus</i> (Martin) and <i>Composita ambigua</i> (Sowerby), which are in		

* An identical rock has been described from the D₂ beds of the Cattybrook section (Smith and Reynolds, 1929, p. 6) and somewhat similar rocks have been recorded from the Coal Measures of Wick (Smith, 1930, p. 343) and from underneath the D₁ beds of the Menai Region, North Wales (Greenly, 1928, p. 392).

	Thick- ness. ft. ins.	Total Depth. ft. ins.
moderate abundance, and fragments of <i>Productus hemisphericus</i> , Sowerby, <i>P. (Buxtonia) scabriculus</i> (Martin) and <i>Orthotetes (Schellwienella) cf. crenistria</i>	3	282 0
Maroon, crinoidal, oolitic limestone with shell fragments ..	6	282 6
Maroon, micaceous, slightly calcareous, argillaceous sandstone	1 6	284 0
Pink limestone with oolites of medium size interspersed with more common smaller ones. The rock is still an oolitic limestone in the basal twelve inches but it also contains frequent pebbles of maroon shale and less commonly pebbles of milky quartz. The fauna is represented by <i>Productus hemisphericus</i> , which is particularly abundant in the lower two feet, <i>P. (Buxtonia) scabriculus</i> , <i>P. (Pustula) elegans</i> , McCoy, <i>Dielasma</i> sp., <i>Spirifer wickensis</i> and <i>Cyphinium</i> sp.	10 0	294 0
Brick-coloured, ferruginous, slightly calcareous sandstone ..	1 0	295 0
Dark, liver-coloured, calcareous shale and earthy limestone, in places coloured greenish-grey	3 0	298 0
Maroon, calcareous shale, part of which did not yield a core	4 6	302 6
Dark, ferruginous, somewhat incoherent sandstone	4 6	307 0
Dark, liver-coloured, calcareous, quartzitic sandstone with occasional quartz pebbles and wisps of maroon shale ..	5 6	312 6
Pinkish-red, foraminiferal, silty limestone with composite grains of calcareous mudstone and numerous faecal pellets; cream-coloured and red oolites are interspersed and occur in bands, the red oolites being coated with a pellicle of iron oxide; occasional bands of maroon shale are also present. <i>Productus hemisphericus</i> and a fragment of an undeterminable fish tooth were recovered	2 6	315 0
Maroon limestone with red and cream oolites interspersed in a dark red matrix; fragmentary <i>Productus hemisphericus</i> is common	4 0	319 0
Grey and pink, foraminiferal, pellet limestone with oolites and grains of calcareous mudstone, yielding <i>Productus hemisphericus</i> , which is particularly abundant in the basal six inches, and <i>Dielasma</i> sp.	5 6	324 6
Dark, liver-coloured, calcareous, quartzitic sandstone with quartz pebbles and a band of sandstone rich in oolites (compare level 275)	5 6	330 0
Liver-coloured, fine-grained, arenaceous limestone	2 0	332 0
French-grey, fine-grained, foraminiferal, oolitic limestone, sometimes stained pink, with occasional quartz pebbles and thin bands of maroon shale. The limestone is most unusual in the beds of the D zone and resembles limestones normally found in the C zone. At the 336 level there occurs a grain limestone (see A. Wood, 1941, p. 195)	8 0	340 0
French-grey and pink, finely oolitic limestone with nests of coarser oolites and <i>Orthotetes cf. crenistria</i> , <i>Phricidothyris cf. lineata</i> , <i>Productus hemisphericus</i> and <i>P. cf. concinnus</i> (Sowerby); the rock is sometimes non-oolitic	2 9	342 9
Dark grey, carbonaceous limestone, and calcareous shale with nodules of iron pyrites	3	343 0
Dark, greenish-grey, carbonaceous shale with undeterminable plant remains; the shale is in part heavily slickensided and shows hexagonal joints at right angles to the bedding ..	3	343 3

	Thick- ness. ft. ins.	Total Depth. ft. ins.
Maroon and green, silty shale containing innumerable, irregular, calcite concretions, and small oolites showing a concentric structure and composed of argillaceous matter and hydrated ferric oxide	4 9	348 0
Light, greenish-grey limestone with many irregular wisps of maroon shale	2 0	350 0
Maroon, quartzitic sandstone	3 3	353 3
Maroon, sandy shale	3	353 6
Crystallised, argillaceous and silty limestone presenting a clotted appearance; the grey clots are composed of calcite and occasional fragmented algal (?) tubes, the interstitial material comprising angular quartz of silt grade set in a richly hæmatitic argillaceous background which is sometimes calcareous	3 6	357 0
Grey and light pink, foraminiferal, oolitic limestone with occasional crinoid ossicles, <i>Productus hemisphericus</i> and <i>Dielasma</i> sp.	3 0	360 0
Grey and pink, close-grained, foraminiferal limestone with numerous comminuted algal (?) tubes	1 3	361 3
Grey and pink, oolitic, foraminiferal, crinoidal limestone with <i>Spirifer wickensis</i> and numerous <i>Productus hemisphericus</i>	2 3	363 6
Grey and pink, oolitic limestone, in parts coarsely oolitic, with interstitial iron oxides arranged as stringers and with a tall form of <i>Productus hemisphericus</i> and many individuals of the normal form	3 3	366 9
Finely oolitic, crinoidal, semicrystalline, greenish-grey and pink limestone containing wisps of iron oxide-rich argillaceous matter	4 3	371 0
Crinoidal, foraminiferal, pinkish, grain limestone with some oolites, broken algal (?) tubes in abundance, and occasional <i>Productus hemisphericus</i>	5 0	376 0
Calcite and limonite vein	3	376 3
Pink, calcareous sandstone with ferruginous oolites, many of which present a broken outline, fæcal pellets, and algal (?) tubes	2 6	378 9
Liver-coloured quartzite	3	379 0
Liver-coloured, conglomeratic quartzite with pebbles of vein-quartz and a lens of white quartzite six inches in maximum thickness	9	379 9
Predominantly liver-coloured quartzite, but with some pale bands, with small pebbles of vein-quartz	7 3	387 0
Uncored; small boulders of quartzite recovered	3 0	390 0
Current-bedded, dark maroon, ferruginous, micaceous siltstone	2 0	392 0
Dark, reddish-grey, crinoidal, oolitic limestone with composite grains of calcareous mudstone and innumerable, broken, algal (?) tubes	9	392 9
Dark, pinkish-grey, oolitic limestone with many algal (?) tubes, fæcal pellets, and foraminifera	2 0	394 9
Current-bedded, crystalline, impure, calcareous mudstone ..	3	395 0

	Thick- ness. ft. ins.	Total Depth. ft. ins.
Impure, argillaceous limestone with calcareous masses occurring in numerous irregular concretions which predominate over the brownish-red, argillaceous, interstitial material (= rubbly limestone)	9 2	404 2
Grey and pink, fine-grained limestone with innumerable, fragmented algal (?) tubes, a few foraminifera and some faecal pellets	1 0	405 2
Semicrystalline, grey limestone with occasional pockets of oolites and bands of irregularly dispersed, maroon shale	2 4	407 6
Pink and grey, oolitic limestone with <i>Productus hemisphericus</i>	2 0	409 6
Liver-coloured, slightly calcareous, micaceous siltstone with occasional bands of vein-quartz pebbles; these beds grade down into more fissile, micaceous sandstones	8 3	417 9
Deep red and grey, crinoidal, oolitic limestone yielding <i>Productus hemisphericus</i> and <i>Orthotetes</i> (<i>Schellwienella</i>) <i>senilis</i> (Phillips)	2 3	420 0
Maroon and green marl	1 6	421 6
Impure, argillaceous limestone with calcareous material occurring in numerous, irregular concretions which predominate over the maroon, argillaceous material (= rubbly limestone)	6 3	427 9
The above-mentioned bed passes down imperceptibly into a maroon grit and then to a maroon quartzitic sandstone ..	1 9	429 6
Dark, greenish, slightly calcareous, argillaceous siltstone in which the quartz of silt grade is associated with micaceous and clay material occurring in small masses of rounded but irregular shape; interspersed between the masses are wisps of argillaceous matter also including some quartz of silt grade. The rock provided the U-shaped worm tube described on p. 445 and figured on pl. 15, fig. 5	2	429 8
Greenish-grey, calcareous, quartzitic sandstone	1 4	431 0
Dark green, red mottled, calcareous shale	2	431 2
Greenish-grey and maroon dappled, rarely crinoidal, silty limestone with <i>Orthotetes</i> (<i>Schellwienella</i>) cf. <i>crenistria</i> ..	1 4	432 6
Dark green, highly argillaceous, crinoidal limestone with <i>Productus</i> (<i>Gigantella</i>) <i>giganteus</i> (Martin)	2 6	435 0
Dark green shale	3	435 3
Limestone showing dark grey areas set in a lighter groundmass (? pseudobreccia). A passage downwards can be seen from a limestone with argillaceous wisps through normal (?) pseudobreccia to a more crystalline variety in which the darker areas are not so clearly distinguished. The dark areas are usually, but not always in higher levels, more crystalline and hence more translucent than the light areas, but their colour is predominantly due to the inclusion of much black dust which cannot be resolved under high power. The microfossils are closely packed throughout both areas and comprise myriads of comminuted algal (?) tubes and many ostracods; foraminifera are moderately common in the lower beds where the rock is more crystalline, but their outline tends to be nebulous	1 9	437 0
Grey, arenaceous limestone	1 2	438 2
Dark greenish-grey and maroon, calcareous shale	6	438 8

	Thick- ness. ft. ins.	Total Depth. ft. ins.
Dark grey, crinoidal, foraminiferal limestone yielding <i>Syringopora</i> sp., <i>Lithostrotion martini</i> , Edwards and Haime, <i>L. junceum</i> , <i>Caninia juddi</i> (Thomson) emend. Lewis, <i>Dibunophyllum bourtonense</i> , Garwood & Goodyear, <i>Palæosmia murchisoni</i> , Edwards & Haime, <i>Carcinophyllum vughani</i> , Salée, Orthotetid fragments, <i>Productus</i> (<i>Gigantella</i>) <i>giganteus</i> and <i>Spirifer</i> sp.	2 1	440 9
Light grey, subcrystalline, crinoidal limestone with <i>Palæosmia murchisoni</i> , <i>Chonetes papilionaceus</i> , Phillips, and <i>Productus hemisphericus</i>	7 3	448 0
Dark greenish-grey, blocky-weathering shale	1 0	449 0
Greenish-grey shale of medium tint with calcareous concretions	6 0	455 0
Grey, coarsely oolitic limestone	2 0	457 0
Predominantly grey, but sometimes pink, grain limestone with faecal pellets, some clastic calcite, comminuted algal (?) tubes, fragments of <i>Koninckopora</i> (see A. Wood, 1943, p. 205) and abundant <i>Productus hemisphericus</i>	11 0	468 0
Grey, subcrystalline limestone with occasional, exceedingly thin, bands of oolite, and <i>Productus hemisphericus</i>	16 0	484 0
Light grey, crinoidal, non-oolitic, foraminiferal, subcrystalline limestone with bands rich in <i>Productus hemisphericus</i> and, at 496 feet, <i>Dibunophyllum</i> sp. In the basal six feet the rock is slightly darker in colour and has yielded <i>Lithostrotion martini</i> , <i>Dibunophyllum bourtonense</i> , <i>Palæosmia murchisoni</i> and <i>Carcinophyllum vughani</i>	52 6	536 6
Dark green and maroon rubbly limestone	6	537 0
Dark, greenish-grey and maroon, non-oolitic, argillaceous limestone with wisps of shale and <i>Syringopora</i> sp., <i>Chonetes septosus</i> (Fleming), <i>Lithostrotion martini</i> , <i>L. junceum</i> (a large form exhibiting <i>Nemistium</i> trend), <i>Dibunophyllum bourtonense</i> , <i>Palæosmia murchisoni</i> , <i>Orthotetes</i> (<i>Schellwienella</i>) <i>cremistris</i> , <i>Productus</i> (<i>Gigantella</i>) <i>giganteus</i> , <i>Productus hemisphericus</i> , <i>Athyris planosulcata</i> , <i>Phricidothyris</i> cf. <i>lineata</i> , <i>Phillipsia</i> sp., and foraminifera	5 0	542 0
Pink, crinoidal, shelly limestone with <i>Syringopora</i> sp., phaceloid <i>Lithostrotion</i> fragment, <i>Palæosmia murchisoni</i> and <i>Composita</i> sp.	1 0	543 0
Medium grey, crinoidal limestone with <i>Palæosmia murchisoni</i> , <i>Chonetes papilionaceus</i> , <i>Productus hemisphericus</i> and <i>P. (Gigantella) giganteus</i>	3 4	546 4
Dark grey, crinoidal limestone with <i>Syringopora</i> sp., <i>Lithostrotion martini</i> with algal investment, phaceloid <i>Lithostrotion</i> , <i>Dibunophyllum bourtonense</i> , <i>Productus</i> (<i>Gigantella</i>) <i>giganteus</i> , <i>Chonetes</i> cf. <i>hardrensis</i> (Phillips), <i>Phricidothyris</i> cf. <i>lineata</i> , <i>Athyris</i> sp., <i>Murchisonia</i> sp, and <i>Solenomorpha minor</i> McCoy	2 8	549 0
Dark, greenish-grey, argillaceous limestone with <i>Productus</i> (<i>Gigantella</i>) <i>giganteus</i> in abundance	1 0	550 0
Dark, greenish-grey, crinoidal limestone with <i>Chonetes</i> cf. <i>hardrensis</i> , <i>Productus hemisphericus</i> , (?) <i>Dielasma</i> sp., <i>Athyris planosulcata</i> , <i>Composita ambigua</i> (Sowerby), <i>Phricidothyris</i> cf. <i>lineata</i> , <i>Straparollus</i> near <i>S. dionsyi</i> (Goldfuss), <i>Cyphinioides ashfellensis</i> , Reed, and ostracods	1 9	551 9

	Thick- ness. ft. ins.	Total Depth. ft. ins.
Light to medium grey, richly crinoidal, foraminiferal, clastic limestone with <i>Lithostrotion martini</i> , <i>Dibunophyllum</i> sp., <i>Palæosmia</i> <i>murchisoni</i> and <i>Pseudamusium</i> sp.	2 3	554 0
Medium grey, crinoidal, crystalline limestone rich in microfossils such as <i>Koninckopora</i> sp., foraminifera and gastropods, and there are also re-crystallised faecal pellets; the rock yielded <i>Dibunophyllum</i> sp., <i>Palæosmia</i> <i>murchisoni</i> , <i>Productus hemisphericus</i> and <i>Solenomorpha minor</i>	2 6	556 6
Maroon, argillaceous and arenaceous limestone with <i>Dibunophyllum</i> sp.	1 2	557 8
Light grey, close-grained limestone	2 4	560 0
Light grey and liver-coloured, calcareous, foraminiferal siltstone	1 9	561 9
Light greenish-grey, argillaceous limestone with small, darker grey areas and <i>Productus (Gigantella) giganteus</i> in abundance	11	562 8
Grey, crinoidal, compact, argillaceous limestone with numerous broken algal(?) tubes, foraminifera, <i>Lithostrotion martini</i> , <i>Chonetes papilionaceus</i> , <i>Productus hemisphericus</i> and (?) <i>Dielasma</i> sp.	9 4	572 0
Grey, crinoidal, compact, argillaceous limestone which yielded <i>Lithostrotion martini</i> , (?) <i>Caninia juddi</i> , <i>Dibunophyllum</i> sp., (?) <i>Carcinophyllum</i> sp. and <i>Productus (Gigantella) giganteus</i>	8 0	580 0
Light grey, crinoidal limestone with <i>Lithostrotion martini</i> , <i>Caninia juddi</i> , <i>Dibunophyllum</i> sp., <i>Productus hemisphericus</i> , a semireticulate productid, <i>Orthotetes (Schellwienella) crenistria</i> (large form) and <i>Phricidothyris</i> cf. <i>lineata</i>	10 6	590 6
Grey, crinoidal, oolitic limestone with occasional <i>Productus hemisphericus</i>	1 9	592 3
Light, liver-coloured, crinoidal, calcareous, medium-grained sandstone grading down into a liver-coloured quartzite; the sandstone yielded abundant <i>Productus hemisphericus</i> and contains algal (?) remains	1 9	594 0
Uncored; although quartzite boulders were recovered, the interval may really be represented by shale	4 0	598 0
Dark grey, carbonaceous, calcareous, blocky shale with undeterminable plant remains	5 0	603 0
Clotted limestone in which dark areas, composed of material of silt and clay grade, are carried in a lighter matrix composed of argillaceous and calcareous matter in which a small amount of quartz of silt grade is present	1 6	604 6
Dark grey, argillaceous, crystalline, oolitic limestone with brachiopod fragments probably of <i>Composita</i>	1 0	605 6
Dark grey, calcareous quartzite	2 6	608 0
Greenish-grey, blocky-weathering, calcareous, arenaceous shale	1 3	609 3
Medium grey limestone with exceedingly thin partings of dark grey, micaceous shale carrying undeterminable plant remains. The limestone is rich in foraminifera, <i>Koninckopora</i> sp., and faecal pellets and oolites are numerous	2 0	611 3
Greenish-grey, calcareous shale with undeterminable plant remains and calcareous nodules	3 3	614 6

	Thick- ness. ft. ins.	Total Depth. ft. ins.
Medium grey, frequently oolitic, silty limestone with <i>Lithostrotion martini</i> and <i>Composita</i> sp. The microfossils include many foraminifera, broken algal (?) tubes, and <i>Koninckopora</i> sp.	4 0	618 6
Grey, calcareous mudstone with numerous wisps of shale, <i>Lithostrotion martini</i> and brachiopod fragments probably of <i>Composita</i>	8	619 2
Medium to dark-grey, fine-grained, bituminous, rarely oolitic, crinoidal limestone with broken shells. Here and there in upper part are small areas of porcellaneous, calcareous mudstone but, as followed downwards, these areas become larger and more numerous so that the rocks assume the usual aspect of the Concretionary Beds. Thin partings and irregular wisps of dark grey shale occur sporadically. Fossils are uncommon except in thin bands where <i>Lithostrotion martini</i> , <i>Productus hemisphericus</i> and <i>Composita ficoidea</i> , Vaughan, have been obtained. The rocks are frequently traversed by thin, calcite-filled joints which show small areas of brown oil within the calcite	46 4	665 6
Dark, greenish-grey shale with a dwarfed fauna concentrated in thin bands. The forms identified include <i>Aviculopecten interstitialis</i> (Phillips), <i>Edmondia</i> sp., <i>Parallelodon</i> sp., <i>Aclisina</i> near <i>A. elongatus</i> (Fleming), <i>Murchisonia</i> sp., fragments of <i>Productus</i> sp. and ostracods	10	666 4
Medium to dark grey, fine-grained, bituminous limestone with numerous porcellaneous masses which are more abundant than in the above-described Concretionary Beds; patches of brown oil are also present in the calcite-filled joints. The fauna includes <i>Lithostrotion martini</i> , <i>Productus hemisphericus</i> , <i>Composita ficoidea</i> and <i>Solenomorpha minor</i>	27 8	694 0

The limestone assumed a constant dark grey colour at the 594 level and there was a marked change in the fauna; the junction between the S and D zones has therefore been drawn at that position. The S beds belong to the S₂ subzone and can be correlated with the Concretionary Beds of the Avon Section as interpreted by Reynolds (1921, p. 242); 100 feet were penetrated in the borehole and, taking the average dip as 32 degrees, a true thickness of 85 feet is obtained. Between the 168½ and 294 levels the beds are certainly of D₂ age, and between 438 feet 8 inches and 594 feet the fauna indicates a D₁ age. This leaves an interval of 144 feet 8 inches where the fossil and lithological evidence both fail. If the junction between the two subzones be taken at the 294 level, a maximum thickness for the D₁ beds is obtained and, correcting for the dip, the true thicknesses are 105 feet for the D₂ subzone, which is incompletely represented owing to the Trias unconformity, and 255 feet for the D₁ subzone. This latter figure should be compared with the 375 feet given by Reynolds (1921, p. 233) for corresponding

beds in the Avon Section. Although some thinning of the divisions of the Carboniferous Limestone is expected towards the north-east, the difference of 120 feet for the D_1 beds in a distance of four miles is not thought probable in view of our knowledge of the other members of the succession.

The following table shows the major stratigraphical divisions and the thicknesses penetrated for the total run of the borehole.

								Thickness		Depth.	
								ft.	ins.	ft.	ins.
Lower Lias	..	..	..	..	..	..	..	55	0	55	0
Rhætic	..	..	..	..	..	..	..	13	0	68	0
(Unconformity not seen)											
Trias	..	..	..	..	..	..	..	100	6	168	6
(Unconformity)											
Carboniferous Limestone	{ D_2 subzone (lower part)						..	125	6	294	0
	{ D_1 subzone						..	300	0	594	0
	{ S_2 subzone (top part)						..	100	0	694	0

PALÆONTOLOGICAL NOTES

Coelenterata

Chætetes septosus (Fleming)

Only one specimen of this characteristic D_1 tabulate coral was collected (539 feet). This has much thickened walls and is meandrine (see Smyth, 1925, pls. xiv and xv), thus having followed in a marked degree the two common trends pursued by the genus.

Caninia juddi (Thomson) emend. Lewis

The form agrees with the diagnostic description given by Lewis (1924, p. 391). The septa are little dilated and the cardinal fossula is inconspicuous (pl. 15, fig. 1, G.S.M.: 71363). Vaughan (1905, p. 276) records the species as *Campophyllum* aff. *murchisoni* but it is not the coral he described and figured under that name (1903, p. 116, pl. i, fig. 5).

Carcinophyllum vauhani, Salée

The form is represented by a few characteristic specimens, one of which is illustrated by the transverse section on pl. 15, fig. 2 (G.S.M.: 71364).

Dibunophyllum

Vaughan (1905, p. 283) distinguished the forms characteristic of the D_1 and D_2 beds by the symbols θ and ψ , yet both are illustrated as occurring on the same block of stone from the D_1 beds of South Wales (1911, pl. xl, fig. 7). Garwood and Goodyear (1924A, p. 259 and 1924B,

p. 560) gave specific names to these, calling *Dibunophyllum* θ , *D. bourtonense*, and *D. ψ* , *D. bristolense*. Hill (1937, p. 67) accepts this specific distinction, but considers that *D. bristolense* is synonymous with *D. bipartitum* (McCoy). It is doubtful, in our opinion, whether in corals so variable in details as the elsiophyllids, this distinction can be maintained, and we are inclined to look on the two as different expressions of a single variable species. Typical representatives of the two forms can be readily distinguished, but there are other specimens in which the diagnostic features are differently associated.

Lithostrotion

The species encountered were almost entirely phaceloid and these occurred at various horizons throughout the Carboniferous strata pierced by the borehole. The absence of cerioid forms can only be looked upon as circumstantial. *Lithostrotion* is the most prolific coral genus in the Viséan, and cerioid forms, if perhaps not so plentiful as the phaceloid, are common in the Bristol district.

Lithostrotion junceum (Fleming)

Large growths of *L. junceum* occurred in the D_2 beds, but only two examples were procured from the D_1 subzone; these latter showed a distinct *Nemistium* trend.

Lithostrotion martini, Edwards and Haime

L. martini may be synonymous with *Lithodendron irregulare*. Phillips (1836, p. 202, pl. ii, figs. 14 and 15 non *Lithostrotion irregulare*, Edwards and Haime, 1851, p. 436 and 1852, p. 198, pl. xli, figs. 1, 1a—e on which the species is generally interpreted) and also possibly with *Erismatolithus Madreporites affinis*, Martin (1809, pl. xxxi), but neither Phillip's nor Martin's figures and diagnoses permit their species to be accurately interpreted, and their types are lost. Edwards and Haime, and those who followed them, interpret *Lithostrotion affine* (Martin) as a larger form than *L. martini*, but neither Martin's figure nor description warrants this assumption; Martin's figure is extremely poor and valueless.

The type of *Lithostrotion martini* recorded from the borehole as characteristic of the D_1 beds (pl. 15, fig. 3, G.S.M: 71365) differs from the one usually met with in the S_2 beds (pl. 15, fig. 4, G.S.M: 71366).

The D_1 form has a large and strongly dilated columella; the septa are long and well-developed. The major septa in most cases reach the columella, and the minor septa are straight and

extend well into the tabularium. The corallites vary in diameter from 8 to 10 mm.

The S_2 form has a less strongly dilated columella, and both the major and minor septa are thinner and shorter than in the D_1 form. The major septa seldom extend to the columella, and the minor septa, which are often extremely thin and sometimes flexuous, do not always reach the inner boundary of the dissepimentarium. The corallites, which vary in size, are about 10 mm. in diameter.

Nemistium edmondsi, Smith

Although the diphylloid type of *Lithostrotion* was surprisingly rare, nemistoid modifications were common in the D_2 subzone.

Polychæta

At a depth of 429 feet 8 inches the D_1 beds yielded a U-shaped worm tube (plate 15, fig. 5, G.S.M.: 71367), the base and one arm of which were preserved complete, the other arm being represented by a short length only. The tube has an average diameter of 15 mm. and the base is 75 mm. long; the complete vertical arm, which is 45 mm. long, is constricted distally where it is 10 mm. in maximum diameter. Little structure is discernible in the tube wall except in the vertical arm where a series of transverse wrinkles are clearly preserved. The tube is now filled with a matrix which is more sandy than the argillaceous siltstone in which it is embedded; the infilling is presumed to have taken place shortly after the decay of the animal, otherwise a partial or complete collapse of the tube might be expected.

The specimen can be best compared among modern worms with the true tubicolous Polychæta, and particularly with such an aberrant type as *Chætopterus pergamentaceus* which forms a U-shaped tube. The tube of the chætopterids is made of a substance resembling parchment, and in these, and indeed in the majority of the Polychæta which form a parchment-like tube, the tube is characteristically crossed by transverse wrinkles. The presence of similar wrinkles on the fossil specimen suggests that during life this may have been made of parchment-like substance, and the typical U-shape further suggests a comparison, but does not imply relationship, with the modern chætopterids.

Generic names have been given to U-shaped tubes, recorded from various stratigraphical horizons, but this practice is not followed

here because the shape is not a generic character but an indication only of a mode of life.

Brachiopoda

The majority of the smaller brachiopods were imperfectly preserved, and many were so fragmentary that it was not possible to name these with absolute certainty. These remarks apply particularly to the forms identified in the borehole record as *Phricidothyris* cf. *lineata*, *Composita ambigua* and *Dielasma* sp.

Productus (*Gigantella*) *giganteus* (Martin)

The *Gigantella* characteristic of the D₁ subzone in the S.W. Province is not the typical *Productus giganteus* as interpreted by Martin's figures (1809, pls. xv and xvi), but is a smaller, rounder form with less pronounced ears and without, or with, slight longitudinal corrugations. It approaches in these respects *Productus edelburgensis*, Phillips, Davidson.

Cephalopoda

Beyrichoceratid

Remarkably few goniatites have been recorded from the local Carboniferous rocks, particularly from the Viséan. One small specimen was collected from the D₁ beds at a depth of 551 feet and we are indebted to Mr. W. S. Bisat for his opinion that it is probably a Beyrichoceratid but that it is too imperfectly preserved to identify with any assurance; he reports that there is a "tendency to a backward trend of the striæ on the flanks" which "suggests that it is from the neighbourhood of the *castletonense* zone or just below it."

Trilobita

Cyphinium sp.

An incomplete cranidium of *Cyphinium* (G.S.M: 71002), a genus erected by Weber (1933, pp. 45 and 81, pls. ii and iii; see also Gorsky, 1939, pp. 145-6, pl. xxxv, figs. 10-14), was obtained at a depth of 287 feet from beds placed by us in the D₂ subzone. No specific name is proposed for the Filton specimen, the generic identification of which was first suggested by Dr. C. J. Stubblefield, because it shows subparallel margins to the glabella and in this respect differs from any of Weber's forms, all of which are recorded from much higher stratigraphical horizons developed in the Donetz Basin.

Cyphinioides ashfellensis, Reed

An incomplete cranidium was obtained from the D₁ beds at a depth of 551½ feet, but sufficient is preserved to indicate an identity with the species recently described from the Ashfell Limestone (C zone) near Kirkby Stephen (Reed, 1942, p. 654, pl. viii, figs. 1, 1a, and 2). The Filton record extends the range of the species.

COMPARISON OF THE LAUNDRY BOREHOLE, FILTON, AND THE NEW BOREHOLE

The Laundry borehole, situated 445 yards to the S 25° E of the new borehole, entered the ground 270 feet above Ordnance Datum; from information supplied by the Contractors, Richardson has published the succession of rocks (1930, p. 234). Seven years after the boring was completed, Mr. H. F. Barke examined some of the remaining cores; a few had been taken from near the base and had been cut from red-stained, grey limestone which provided a fauna typical of the D zone (Moore and Trueman, 1939, p. 52) while higher cores consisted of gypsum, indicating Triassic deposits. A few of the limestone cores can still be examined and their lithology is suggestive of the D₂ subzone. There is no doubt that the Contractors' geological information was misleading, and we consider that, of the succession published by Richardson, the 'Cattybrook clay' is probably the black Rhætic shale, the 'shale, red clay and blue pennant,' the red marls, Tea Green Marls and possibly a development of the Dolomitic Conglomerate of the Trias, and the 'blue and red pennant with interbedded shales' the Carboniferous Limestone. The modified record will then read as follows:

	Thickness		Depth	
	ft	ins.	ft.	ins.
Lower Lias and Upper Rhætic (Cotham Beds) undifferentiated	78	8	78	8
Lower Rhætic (Westbury Shales)	25	4	104	0
Trias	94	6	198	6
Carboniferous Limestone (D ₂ subzone)	198	0	396	6

The Westbury Shales are 25 feet 4 inches thick while in the new borehole they do not exceed 10 feet. Such a relatively great difference is not likely to have arisen through faulty recording as the beds are most distinctive, and the probable explanation is that the Westbury Shales are thinning in a north-westerly direction against a ridge formed of Carboniferous Limestone flanked by Triassic deposits.

The Carboniferous Limestone at the two boreholes can be assumed to possess an average dip of about 32 degrees in a south-easterly direc-

tion. If the intersections of the base of the D_2 beds at the new borehole and of the bottom level of the Limestone in the Laundry borehole with the almost horizontal Carboniferous-Trias unconformity are plotted in each case on the map along north-west lines, there is at once an obvious discontinuity in the strike, which amounts to a distance of at least 300 yards measured across the strike. As the Carboniferous Limestone is deeply covered by a mantle of Mesozoic rocks, the true direction of dip cannot be precisely ascertained by the methods available, but in order to make the strike lines conform, a sudden swing in the outcrop to the north-north-west through 65 degrees would be necessary, and this is most improbable. Hence, between the two boreholes a fault is postulated, trending possibly north-westwards and possessing a displacement of approximately 300 yards; the near proximity of a fault is disclosed by the borehole because of the heavily mineralised fault-breccia and wide joints which cross the D_2 sediments between the $210\frac{1}{2}$ and 218 levels, and the calcite-filled, close joints of the D_1 and S beds.

Our thanks are due to the Directors of the Bristol Aeroplane Company for affording us every facility to examine the cores and to Mr. W. B. Mackenzie for his interest and unstinted help. Mr. D. F. Ashby has given his valued assistance regarding petrological matters. A grant towards the cost of publication has been made from the Colston Research Fund, which is administered by the University of Bristol.

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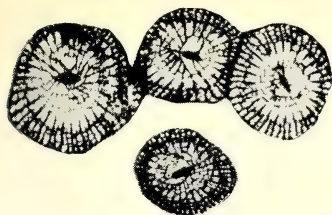
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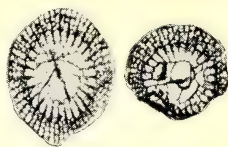
EXPLANATION OF PLATE 15

(All the specimens are from the Carboniferous Limestone of the Filton borehole.)

- Fig. 1. *Caninia juddi* (Thomson) emend. Lewis. D₁ subzone, depth 440 feet. G.S.M: 71363. X 1½. Page 443.
- Fig. 2. *Carcinophyllum vauhani*, Salée. D₁ subzone, depth 534 feet. G.S.M: 71364. X 1½. Page 443.
- Fig. 3. *Lithostrotion martini*, Edwards and Haime. D₁ subzone, depth 540 feet. G.S.M: 71365. X 1½. Page 444.
- Fig. 4. *L. martini*, Edwards and Haime. S₂ subzone, depth 617 feet. G.S.M: 71366. X 1½. Page 445.
- Fig. 5. U-shaped worm tube from the D₁ subzone at a depth of 429 feet 8 inches. G.S.M: 71367. X 1. Page 445.



3



4



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2



5

CARBONIFEROUS LIMESTONE FOSSILS

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<i>*</i>	Kearns, H. G. H., Ph.D., B.Sc., F.R.E.S.	The Research Station, Long Ashton, Bristol	
<i>*</i>	Kellaway, G. A., B.Sc., F.G.S.	Geological Survey and Museum, South Kensington, London, S.W.7	<i>G.</i>
<i>*</i>	Kendall, Lt.-Col. O. D., M.A.	3 Old Sneed Road, Stoke Bishop, Bristol, 9	
<i>A.</i>	King, B.	Mayfield, Uplands Road, Saltford, Bristol	<i>B.O.</i>
<i>A.</i>	King, Mrs. B.	Mayfield, Uplands Road, Saltford, Bristol	<i>O.</i>
<i>A.</i>	Kromler, A. A.	45 Summerleaze, Fishponds, Bristol	<i>E.</i>
	Lace, P. D.	5 Downfield Road, Clifton, Bristol, 8	<i>B.F.G.</i>
	Lankshear, Miss B., B.Sc...	24b Gloucester Road, Bristol, 7	<i>G.</i>
<i>*</i>	Leach, A. C., M.A.	Clifton College, Edgecombe, Bude	<i>O.</i>

A.	Lodge, Mrs.	5 Worcester Terrace, Clifton, Bristol, 8	B.
	Loupekine, I. S., B.Sc., F.G.S.	The University, Bristol, 8	G.
	Lowe, E. E., B.Sc., Ph.D.	17 Southfield Road, Westbury-on-Trym, Bristol	E.
	Loxton, Miss D. M.	22 College Road, Clifton, Bristol, 8	F.O.
	Marsden, A., M.Sc., F.I.C.	161 Bishop Road, Bishopston, Bristol, 7	G.
	Marsden, Mrs.	161 Bishop Road, Bishopston, Bristol, 7	F.G.
J.	Martin, A. B.	90 North Road, Bristol, 6	G.
*	Matthews, L. H., M.A., Sc.D.	27 Hanbury Road, Clifton, Bristol, 8	O.
	Maunder, G. S., B.Sc.	Newhaven, Moor Lane, Station Road, West Town, Bristol	F.G.
	Maxwell, H. W.	10A Downfield Road, Clifton, Bristol, 8	F.O.
	Maxwell, Mrs.	10A Downfield Road, Clifton, Bristol, 8	F.
A.	McInnes, Miss J.	The Training Hospital, Fishponds, Bristol	B.O.
*	McMurtrie, G. E. J.	Eastfield House, Westbury-on-Trym, Bristol	F.G.
	McMurtrie, Mrs.	Eastfield House, Westbury-on-Trym, Bristol	F.
	Mead, Miss C. E., B.A.	16 Quadrant West, Hillfields Park, Bristol	F.G.
	Melluish, F./Lt. W. D.	28 Downleaze, Bristol, 9	O.
A.	Mogford, C. J.	13 Park Grove, Westbury Park, Bristol, 6	F.G.
A.*	Mogg, G.	483 Fishponds Road, Bristol, 5	F.O.
*	Moore, L. R., B.Sc., Ph.D., F.G.S.	University College, Newport Road, Cardiff.	
	Morris, Miss M.	<i>Evening World</i> , Colston Avenue, Bristol, 1	F.O.
A.	Morrison, Miss A. M. C. ..	8 Richmond Hill, Clifton, Bristol, 8	F.O.
	Morrison, Miss E. J. D., M.A.	49 Victoria Road, Chester	
A.	Neal, H. W.	70 Trymside, Sea Mills, Bristol, 9	O.
A.	Nettle, Miss E. C.	3 Beaufort Road, Kingswood, Bristol	F.
	Norgrove, J. W.	22 Alma Road, Clifton, Bristol, 8	E.
J.	Paddon, C. J.	24 Wanscon Walk, Westbury-on-Trym, Bristol	O.
	Parsons, C. R.	H.Q. 40 Group, R.A.F., Andover	
	Payne, T. H.	Compton House, Chew Stoke, nr. Bristol	
*	Peach, A. H.	5 Hanbury Road, Clifton, Bristol, 8	E.O.
*	Pearman, J. V., F.R.E.S.	56 Clifton Park Road, Clifton, Bristol, 8	E.
A.	Pedler, H. H.	21 Clift Road, Ashton Gate, Bristol, 3	G.
	Potter, Miss E. A.	Westonbirt, at Bowood, Calne, Wilts.	O.
J.	Poulding, R. H.	9 Carters Buildings, Portland Street, Clifton, Bristol, 8	O.
	Pratt, Miss D. L.	1 Hughenden Road, Clifton, Bristol, 8	B.F.

* Purchon, R. D., B.Sc., Ph.D.	c/o Clouds Hill House, St. George, Bristol, 5	O.
A. Race, Miss E. M.	16 Upper Belgrave Road, Clifton, Bristol, 8	F.
* Reynolds, Prof. S. H., M.A., Sc.D., F.G.S.	13 All Saints' Road, Clifton, Bristol, 8	G.O.
Richards, G.	5 St. Aubyn's Avenue, Weston- super-Mare	F,G,
Ross, F. Stenhouse	25 Tugela Road, Uplands Estate, Bristol, 3	G.
Ross, James, M.A., F.L.A.	Central Library, Bristol, 1	
Rowley, G. D.	14 Boston Avenue, Reading	
Rutter, Miss E. M.	32 Henleaze Gardens, Bristol, 9	B.E.
A. Salmond, P. W.	22 Tyndall's Park Road, Clifton, Bristol, 8	F.G.
Salter, Miss J. E. R., B.A.	74 Reading Road, Woking	B.
* Sandwith, Mrs.	26 Canynge Square, Clifton, Bristol, 9	B.E.
Saunders, Miss C. E.	25 Robertson Road, Eastville, Bristol, 5	
Savory, J. H.	23 Westbury Road, Westbury-on- Trym, Bristol	O.
Savory, Mrs. J. H.	23 Westbury Road, Westbury-on- Trym, Bristol	O.
Scadding, T. H.	7 Brecon Road, Henleaze, Bristol	O.
+ Sease, R. P.	Lower Northend Farm, Batheaston, Bath	B.
Shaw, Miss D.	38 Logan Road, Bishopston, Bristol, 7	B.
* Shaw, Miss T.	12c Kingsdown Parade, Bristol, 6	B.F.G.
A. Shilstone, H. C.	124 Victoria Avenue, Redfield, Bristol, 5	G.
A. Simmons, Miss L., L.R.A.M.	47 Grosvenor Road, St. Paul's, Bristol, 2	F.O.
* Skene, Prof. Macgregor, D.Sc., F.L.S.	The University, Bristol, 8	B.F.
Skene, Mrs.	36 Lawrence Grove, Westbury-on- Trym, Bristol	
Skinner, D. M.	Westacres, Brentry Hill, Bristol	O.
Skinner, R. A.	Westacres, Brentry Hill, Bristol	O.
Smith, D. Munro, M.R.C.S., L.R.C.P.	Norfolk House, Overnhill Road, Downend, near Bristol	B.O.
Smith, E. L.	18 Carnarvon Road, Redland, Bristol, 6	F.G.
Smith, P. G. Munro	Norfolk House, Overnhill Road, Downend, near Bristol	B.O.
* Smith, Stanley, M.A., D.Sc., F.G.S.	The University, Bristol, 8	G.
Smithson, Miss E.	27 Redland Hill, Bristol, 6	B.
J Spink, Miss W.	Downesway, Falcondale Road, West- bury-on-Trym, Bristol	F.O.
A. Stanhope, Rev. A. J.	"Jesmond," 182 Bishop Road, Bristol, 7	F.G.
A. Strothers, Miss G. M., B.Sc.	49 South Field Avenue, The Park, Kingswood, Bristol	B.O.
Studer, J.P., B.Sc.	44 Clifton Park Road, Bristol, 8	G.
J. Tadd, A. D.	18 Fitzgerald Road, Bristol, 3	O.
Taylor, Miss A. E.	16 Cotham Road, Bristol, 6	O.
A. Taylor, G. H.	107 Sylvan Way, Sea Mills, Bristol	F.

	Taylor, Miss M., D.Sc.	The University, Bristol, 8	<i>O.</i>
	Taylor, W. R., M.A.	Clifton College, Edgcombe, Bude	
*	Tetley, H., B.Sc., F.Z.S., M.B.O.U.	4 The Avenue, Sneyd Park, Bristol, 9	<i>E.O.</i>
	Tetley, Mrs.	4 The Avenue, Sneyd Park, Bristol, 9	<i>O.</i>
<i>J.</i>	Trenerry, G. G.	Windover, 54 Kellaway Avenue, Bristol, 6	<i>O.</i>
*	Trueman, Prof. A. E., D.Sc., F.R.S., F.G.S.	The University, Glasgow	<i>G.</i>
	Trueman, Mrs. A. E. ..	c/o The University, Glasgow	<i>G.</i>
	Tucker, B. W., M.A., M.B.O.U.	9 Marston Ferry Road, Oxford	<i>O.</i>
	Turner, H. W., M.A., F.G.S.	The University, Bristol, 8	<i>G.</i>
*	Wallis, F. S., D.Sc., Ph.D., F.G.S.	The Museum and Art Gallery, Bristol, 8	<i>F.G.</i>
<i>A.</i>	Walsh, Miss C. L. B.	8 Alma Vale Road, Clifton, Bristol, 8	<i>F.</i>
<i>A.</i>	Walters, S. M.	Winford Hospital, near Bristol	<i>B.</i>
	Wareham, Miss F.	252 Charlton Road, Kingswood, Bristol	<i>O.</i>
*	Warne, L. G. G., M.Sc., Ph.D.	Botany Dept., Manchester University	
<i>A.</i>	Warwick, Miss E.	22 Fernbank Road, Bristol, 6	<i>F.</i>
	Webb, H. Vicars	58 Belmont Road, St. Andrew's, Bristol, 6	<i>F.O.</i>
	Weir, Mrs.	Hursley Hill, Whitechurch, nr. Bristol	<i>O.</i>
<i>J.</i>	Weir, D. A.	Hursley Hill, Whitechurch, nr. Bristol	<i>O.</i>
	Weir, G. M.	Hursley Hill, Whitechurch, nr. Bristol	<i>O.</i>
*	Welch, F. B. A., B.Sc., Ph.D., F.G.S.	H.M. Geological Survey, South Kensington, S.W.7	<i>G.</i>
	Weston, F. J.	The Tynings, Chew Stoke, nr. Bristol	
*	Whittard, Prof. W. F., D.Sc., Ph.D., F.G.S. ..	The University, Bristol, 8	<i>G.</i>
<i>J.</i>	Widdowson, R. W.	Kingswood Training School, Bristol	<i>F.G.</i>
<i>J.</i>	Williams, B. H.	50 Upper Cranbrook Road, Redland, Bristol, 6	<i>E.F.O.</i>
<i>J.</i>	Williams, H.	186 Redland Road, Bristol, 6	<i>B.G.</i>
	Wills, R. T.	40 Claremont Road, Bishopston, Bristol, 7	<i>O.</i>
<i>J.</i>	Wright, M. A.	"Rockleaze," Claremont Avenue, Bristol, 7	<i>B.G.</i>
<i>J.</i>	Yeatman, John	45 Downs Cote Road, Westbury-on- Trym, Bristol	<i>F.</i>
*	Yonge, Prof. C. M., D.Sc...	The University, Bristol, 8	

Honorary Members

- R. M. Prideaux, F.R.E.S., Brasted Chart, near Sevenoaks, Kent
 *Sir Ernest Cook, D.Sc., 40 Alma Road, Clifton, Bristol, 8
 *H. Womersley, F.R.E.S., A.L.S., 36 Wattle Street, Fullerton Estate, Adelaide,
 S. Australia
 A. Selley, 116, Coronation Road, Bristol, 3
 *J. W. Tutchter, M.Sc., 57 Berkeley Road, Bishopston, Bristol, 7

REPORT OF COUNCIL

1943

IT is satisfactory to report that, during the fifth year under war conditions, your Society has been able to maintain its organisation and, even with reduced activities, has attracted more members. In order to prepare for the future, it is essential that societies such as ours should continue their existence during the war even if only on a skeleton basis. At the close of 1943 the total membership was 217 compared with 194 at the end of 1942.

It is with deep regret that we record the death of Mr. James Rafter, M.A., who was president of the Society in 1927, 1928 and 1929, Mr. D. F. Ashby, B.Sc., the Honorary Secretary of the Geological Section, whose sudden death occurred in a drowning accident during the Summer, Dr. J. J. Powell and Mr. W. N. Reed.

During the early part of the year all meetings were held on Saturday afternoons but in spite of black-out conditions it was possible in the Autumn of 1943 to revert to evening sessions.

At the Annual General Meeting held on 16 January, Mr. H. Tetley, B.Sc., and Professor C. M. Yonge were re-elected President and Vice-President respectively, Mr. H. O. Edmonds was elected Vice-President, and Mr. Ivor Evans and Mrs. C. Sandwith filled the remaining vacancies on Council.

Your Society has co-operated with the University Committee of the Nature Reserves Investigation Committee and appointed as delegates Mrs. G. M. E. Bell, and Messrs. H. H. Davis, F. W. Evens and A. H. Peach.

M. DORIS HILEY, *Hon. Secretary.*

HON. LIBRARIAN'S REPORT

1943

ADDITIONS to the library during 1943 include some thirty bound volumes of *Proceedings* kindly presented by the Dorset Natural History and Archæological Society in exchange for a set of our own *Proceedings*. The Croydon Natural History and Scientific Society has also been able to supply two parts of its *Proceedings* now out of print. The Library possesses only very incomplete runs of the *Memoirs*, and *Annals*, of Queensland Museum. It is therefore a pleasure to be able to report that the Librarian of that Institution has promised to send all the missing parts (except one, now out of print) after the war.

The Society is indebted to Mrs. Wiseman of Winscombe for the presentation of books and to the Botanical, Entomological, Geological and Ornithological Sections for the journals to which they subscribe. The *Zoological Record* for 1941, and the magazine *Countryside* have been received by subscription.

Notice has been received that publication of the *Annual Report of the Southport Scientific Society* has been temporarily suspended.

The sale of partial runs of four journals realized the useful sum of £15, which will help to combat the ever-increasing spectre of arrears of binding.

H. GORVETT, *Hon. Librarian.*

REPORT OF BOTANICAL SECTION

1943

MR. F. W. EVENS opened the January meeting with a paper on "Scottish Naturalists of the early 19th Century," going fully into the life of Robert Dick, a keen observer and collector.

In February Mr. A. Gunnér raised a discussion on rare plants and the advisability of taking specimens.

The March meeting was devoted to *Violas*.

From April to September material was plentiful, including *Calamintha ascendens*, var. *Briggsii*, *Poterium officinale*, *Thlaspi alpestri*, *Phyteuma orbiculare*, *Thesium humifusum*, *Polygonatum officinale* and *Senecio sylvaticus* var. *discoideus*.

At the exhibition meeting, Mr. F. W. Evens showed seeds under the microscope; Mrs. Sandwith, tree seedlings from her garden; Mr. Max Walters and Mrs. Bell combined in *Alchemillas* and hybrid *Violas* with the parents, showing both growing plants and herbarium specimens.

October was devoted mainly to adventitious buds.

In November the Rev. R. Jeffcoat brought a collection of 154 pressed specimens of South African plants, comprising a fine series of the Cape Heaths which he presented to the Section.

A meeting on Fungi in December closed the year's work. Coloured plates of fifteen edible and nine poisonous species were shown with the aid of the epidiascope, followed by a discussion on living specimens.

"*Spartina*" is increasing rapidly on the Avon and at Aust, but the year produced hardly a flower on the local "*Sorbi*."

Sectional numbers are keeping up, seven new members having joined during the year against three resignations.

ETHEL M. E. BELL, *Hon. Secretary.*

REPORT OF ENTOMOLOGICAL SECTION

1943

THE 79th Annual Meeting was held on 6 February, 1943, and reported upon in last year's *Proceedings*.

During the year the membership was increased from 11 to 21 members, so it will in future be possible to arrange normal and more ambitious meetings.

On 6 March a meeting was held at the Museum when Mr. Tetley exhibited life histories of a few moths from the collection of the late Mr. Charles Bartlett which has been presented by his widow to the Museum.

On 3 July there was a Field Meeting at which 13 members were present. The district visited was Backwell. The day was fine and sunny and a number of insects were seen and examined. Tea was provided at The George, Failand, and it was afterwards agreed to hold a Field Meeting yearly.

On 16 October a meeting was held at 5 Hanbury Road. Six new members were elected and exhibits were shown by some of those present.

On 4 December a meeting was held in the Wigglesworth Library at which 14 members and 4 visitors were present. Three new members were elected. Dr. H. W. Miles, of the Long Ashton Research Station, kindly gave a lantern lecture on the Saw Fly. The slides were many and varied. A vote of thanks, proposed by the President, to Mr. Miles for his most interesting lecture was carried with applause.

A. H. PEACH, *Hon. Secretary*.

REPORT OF FIELD SECTION

1943

DURING 1943 the meetings of the Field Section were carried out on a war-time basis of visits to selected areas within easy distance of the City.

It was decided to circularise members each month of the forthcoming meetings. This has proved a satisfactory innovation and produced an average attendance of 24 members at each of the five meetings. The various meetings of the Botanical, Entomological, Geological, and Ornithological Sections were published on this monthly programme.

On 1 May Mr. H. O. Edmonds led a party to Cribb's Causeway and Henbury; and on 25 May Mr. G. S. Maunder dealt with Cheston Combe, Backwell Hill and Farleigh Combe. Mr. F. W. Evens selected Nailsea and Tickenham as the area for 26 June; on 24 July Mr. G. E. J. McMurtrie visited Chew Magna and Stanton Drew, whilst on 11 September Sir Lewis Fermor led a party to Whitchurch and Keynsham.

We regret to record the death of Mr. W. N. Reed. The membership now stands at 53.

M. DORIS HILEY, *Hon. Secretary*.

REPORT OF GEOLOGICAL SECTION

1943

AT the Annual General Meeting held on January 23 Professor Gordon was re-elected President and Professor Whittard Vice-President; Mr. Ashby, Mrs. Marsden and Mr. McMurtrie were again elected Hon. Secretary, Hon. Treasurer and Hon. Auditor respectively. Sir Lewis Fermor, Mr. Gunner, Mr. Hudson, Professor Reynolds, Dr. Stanley Smith and Dr. Wallis were appointed Committee members. Two lectures followed the formal business: Mr. Turner chose as his subject "Building Stones of the Bristol District" and Mr. Ashby, prompted by the bicentenary of Haüy's birth, recalled some of the contributions made by "René Just Haüy (1743-1822), the Pioneer Crystallographer."

On February 15 Professor E. J. Garwood, F.R.S., delivered a much-appreciated lecture on "Glaciers in the Arctic and in the Alps"; in addition to the descriptions of his own stimulating researches in Spitsbergen and in the Alps, the lecturer gave many reminiscences of men whose names are now famous in polar exploration.

Professor W. G. Bennett of King's College, London, had a large audience at the Open Meeting on March 13 for his lecture-demonstration on "Crystals in Polarized Light." By means of an arc-lamp and suitably arranged lenses, many preparations of minerals and chemicals were projected on to a screen and their optical characters explained.

Four excursions were held during the summer. The Queen Charlton, Keynsham and Portbury areas and the Filton Borehole were visited under the leadership respectively of Mr. Ashby, Dr. Wooldridge, Dr. Stanley Smith and Professor Whittard.

On October 23 Mr. C. W. Blackburn ably presented the water-engineer's views regarding water-supply problems when he took as his subject "Water Engineering and Geology"; this lecture proved of considerable popular interest and provoked a lively discussion.

The last lecture of the session was provided by Dr. F. S. Wallis who, under a title of "Some Geological Problems in Archæology," clearly demonstrated by reference to Stonehenge, the pottery at Pant-y-saer in Anglesey, and to Neolithic and Bronze Age stone axes how geological information can supply critical evidence to the archæologist.

By the untimely death of Mr. D. F. Ashby the Section has lost the services of a most capable Secretary, who by his enthusiasm had increased local interest in geology. Dr. J. J. Powell and Mr. W. N. Reed died during the year after a long association with the Section.

As new members we welcome Messrs. E. V. Bacon and T. Kamester, and Master M. B. Eveson. Membership now stands at 67.

REPORT OF ORNITHOLOGICAL SECTION

1943



A PART from occasional field observations carried out by individual members, the activities of this Section have been entirely confined to meetings. These, six in number, have for the most part been held on Saturday afternoons and, though this is by no means convenient for all, the attendance has usually been well up to the average. As may be gathered below, members have been privileged to hear a variety of highly interesting lectures.

At the *January* meeting the President, in speaking on "Extinct Birds," showed a good series of slides from plates in Lord Rothschild's important work on that subject. The lecturer stated that more than seventy species are known to be extinct and he mentioned the Dodo, Great Auk and Passenger Pigeon as classic examples of birds exterminated through the agency of man. Remarks followed on the unique case of the Stephen Island Wren, and on the mysterious disappearance of the Réunion Starling and the Labrador Duck. For the *February* meeting Mr. H. N. Southern journeyed from Oxford to give a lantern talk on "Birds at Home and Abroad." In this the speaker dealt largely with bird-life in Scandinavia, and among the many species described and shown on the screen were Snow-Bunting, Fieldfare, Redwing, Long-tailed Duck and Wood-Sandpiper. In *March* Prof. C. M. Yonge lectured, with slides, on "Animal-life of the Seashore" and divided his account into three parts—the rocky shore, the sandy shore, and animal life of surface waters. Details were given on the general habits and migrations of the Limpet, while Sea-anemone, Star-fish, Octopus and other forms were described and beautifully illustrated.

A lantern lecture entitled "Observations on some Siberian Birds" was given by the President at the first of two meetings in October. This account was based on the results of expeditions to Lapland and the Taimyr Peninsula by the late Mr. H. Leyborne Popham, and included details of the first discovery, in 1897, of the nest and eggs of the Curlew-Sandpiper. Slides were from photographs by Mr. Popham, and among interesting species shown at the nest were Pine-Grosbeak, Little Stint and Spotted Redshank. Illustrations of nests and eggs included those of Bewick's Swan, Bean and Red-breasted Geese. Later in the month the Rev. F. L. Blathwayt gave an excellent talk when he spoke on "My Field Note-books of half a Century." In this, members were given a detailed account of ornithological observations made during the lecturer's residence within the five counties of Herefordshire, Somerset, Lincolnshire, Dorset and Gloucestershire. The song of the Tree-Sparrow, the occurrence, on spring passage, of Water Pipits at Weymouth and the breeding of the Roseate Tern at Abbotsbury were among the many notes of special importance. Finally, at the *November* meeting, Miss P. Barclay-Smith spoke on "Wild-life in Poland and Czechoslovakia"—the outcome of a visit to that area in 1936. The mammal fauna of Poland, stated to be richer than that of any other part of Europe, was particularly referred to, while, of bird-life, details were given and slides shown of such species as Penduline Tit, Eagle-Owl and White Stork. Illustrations of mammals met with in the Tatra Mountains of Czechoslovakia included those of Marmot, Lynx, Chamoix and Roe Deer.

New-comers have more than made up for resignations, and the membership list, including those serving with the Forces, now totals 75.

H. H. DAVIS, *Hon. Secretary.*

Account of the Annual and General Meetings

1943

THE 80th Annual Meeting of the Society was held in the Wiglesworth Library of the University of Bristol on Saturday, 16 January, when the President, Mr. H. Tetley, was in the Chair. The reports of the Hon. Treasurer, Hon. Librarian and Hon. Secretary were read and adopted. Mr. H. Tetley and Professor C. M. Yonge were re-elected President and Vice-President respectively. Mr. H. O. Edmonds was elected Vice-President, and the remaining officers were re-elected.

Mr. H. Tetley in his Presidential Address dealt with "Animals and their Surroundings." He gave an example of the interdependence of plants, soil and animals which suggested that a detailed survey of an area might well provide useful data for factors affecting animal life (see *Proc.* for 1942, p. 359).

At a General Meeting on 25 March in the Wiglesworth Library, the President was in the Chair and Sir Lewis Fermor gave a lecture on "Gondwanaland, a former Southern Continent." The lecture was illustrated by lantern slides and the epidiastroscope (see p. 483).

The General Field Meeting on 26 June was held at Nailsea and Tickenham and led by Mr. F. W. Evens.

At a General Meeting held on 7 October, the President, who was in the Chair, referred to the sudden death of Mr. D. F. Ashby, Honorary Secretary of the Geological Section, by which the Society and the Department of Geology of the University of Bristol had suffered a great loss. Reference was also made to the death of Mr. W. N. Reed, who had been a regular attendant at general meetings. Mr. R. Bassindale gave a graphic lecture on "Spiders" which was illustrated by a large model of a spider and also different kinds of webs. He dealt fully with details of the life history and with the construction of webs.

On Saturday, 5 November, a General Meeting was held in the Senior Botanical Laboratory of the University and took the form of an Exhibition Meeting. The President, Mr. H. Tetley, was in the Chair. Detailed explanations of the exhibits were given by the respective exhibitors.

M. DORIS HILEY, *Hon. Secretary.*

PRESIDENTIAL ADDRESS, 1943

(Read, Jan. 27, 1944)

Biology and Nature Reserves

By H. TETLEY, B.Sc., F.Z.S., M.B.O.U.

LAST year I tried to give you some idea of the limitations of animals, whether in distribution or food-supply, and of how some may vary considerably in external form and others little or not at all. This evening I would like to continue this story, showing how in one case the existence of one animal may be interwoven with that of another and how a study of it may show something of the history of these islands and of other factors affecting its existence. This will lead up to other inter-relations which should be studied in managing any areas of Nature Reserves, and lastly I shall deal with proposed plans for establishing various types of Reserves in this Country.

The animal chosen is the Field Vole (*Microtus*), a small rodent which is very common in most parts of the British Isles, though, with the two other Voles, it is absent from Ireland and the Isle of Man. It occurs throughout Scotland and the Scottish islands, with the striking exceptions of Lewis and Harris, in the Outer Hebrides, and the Shetlands. There are two species, *M. orcadensis* inhabiting the Orkneys and *M. agrestis* the rest of this area. This distribution, as has been recently pointed out (McWilliam, *British Birds* XXXIV. pp. 203, 204, 1941), apparently has a remarkable effect on the Short-eared Owl (*Asio f. flammeus*) which uses it as its principal food-supply. This Owl is a daylight feeder in open country such as marshes and moorlands and breeds in many parts of the country from Norfolk northwards, but only very exceptionally, if at all, in Ireland, the Isle of Man, Lewis and the Shetlands, i.e. in just those areas where the Field Vole is absent. It has a much wider distribution in winter. It seems therefore as if there is something in the Vole which is vital for the breeding of the Owl and certainly, during plagues of these Voles, it is far more prolific than usual and may nest much earlier. Abroad, *Microtus* has a very wide distribution throughout the Northern

Hemisphere, as has the Short-eared Owl, and, with one exception, the latter breeds wherever the Voles are found, though the Voles extend considerably to the south beyond the Owl's range. The exception is Iceland where apparently the Owl breeds though no Voles are found there. Thus the interdependence of these two animals is close, and certainly the problem would merit further investigation.

Then the Field Vole is of further interest in giving clues to the past history of these islands. Zeuner, according to G. E. Pilgrim,* has indicated that the Straits of Dover were dry during the several stages of glaciation of Pleistocene age, and at those times the Voles could have crossed from the Continent, from which region the original Voles must have come. But in common with a number of other British Mammals they arrived on the west coast too late to find a dry crossing to Ireland and the Isle of Man and were denied access to those regions. These Voles are creatures of open, rough and frequently mountainous country, so are hardy and they might be found on the edge of a glaciated area. The Outer Hebrides were heavily glaciated and the Voles may have retreated in front of the advancing ice sheet, finding refuge in places which were not completely ice-covered. When the ice sheet retreated, the Voles would thus have been able to return to various islands, but the channel between Harris and North Uist, now eight miles wide, must already have existed and so cut off their advance into that island. Much the same may have happened in the case of the Shetlands.

In common with many other Rodents, these Voles provide examples of cycles of change in their numbers. Through some favourable circumstance such as a mild winter and plenty of vegetation, their numbers may increase enormously—sufficient to form a plague. Fortunately, such an event is rare in this country, but in 1891-3 a large area of grazing land in southern Scotland was severely damaged in this way. At such times, animals preying on the Voles turn up in large numbers, and disease may come in, and so the population drops once more.

It has been possible, in the much more spacious lands of northern Canada, to work out such cycles more fully. Using the returns of the fur-traders of the Hudson Bay Company, it has been found that the numbers of fur-bearing animals such as Wolf, Fox and Lynx run in cycles corresponding closely with those of the Hares on which they feed. Lemmings are well-known for such increases and subsequent

* *Geol. Mag.*, LXXXI, 35

migrations; this again leads to increase in the number of Snowy Owls and Rough-legged Buzzards which feed largely on them.

The Field Vole is thus an example of a Mammal which seems closely bound up with the life of a Bird; it also shares in cycles of increase and decrease which affect its predators. Lastly, it can tell us something of the history of these islands.

There are two further remarkable examples of inter-relations.

In Eastern Australia lives a marsupial, the Koala or Native Bear (*Phascolarctos cinereus*). This feeds exclusively on the leaves of the Eucalyptus or Blue Gum, a tree which has long leaves and is a striking feature in that part of the Continent. But there are only certain species of the tree which suit the Koala, and so the latter, which is entirely arboreal, lives a limited existence, distinctly in a "niche."

The second instance is very different and is from our own country. The Large Blue (*Maculinea arion*) is a well-known butterfly which, though formerly much more widespread over southern England, is now very local, occurring only in some parts of Cornwall, Devon, the Cotswolds and Wilts. Its existence is closely bound up with Wild Thyme, which is a common plant in Britain. But it is also closely connected with ants, and nests of the common yellow ant (*Donisthorpea flava*) were present at the base of all plants of Thyme where the butterfly-larvæ were found by Mr. F. W. Frohawk. The symbiosis between these two is close and the ants feed on a sweet liquid exuded by the larvæ. Later, the latter leave the plant and wander about and, it is now known, enter the nest of another ant, *Myrmica scabrinodis*, which is also common. Here they feed on the ant-larvæ and complete their development. This is a remarkable history, especially in the change from one ant-host to another, the ant-larvæ of the first species being unsuited to the butterfly-larvæ as food in its later stages.

So far the inter-relations of one wild animal with another have been given, but a few examples must be added where man is concerned.

The herds of Big Game in Africa, now very much diminished, are reservoirs of the parasites which cause sleeping-sickness (*trypanosomiasis*) in man and his horses, cattle, etc., and which are carried by Tse-tse flies (*Glossina*). This disease does considerable damage in wide areas but the parasites live harmlessly in the Game, which no doubt have become immune during countless generations. Some balance will have to be found between adequate development of the country and the control of Tse-tsés and Big Game. Large reserves, such as the Kruger National Park in South Africa and others in East

Africa, have already been formed to preserve the present numbers of Big Game.

Some years ago the fishing on a river in Australia became bad, a state of affairs which was ascribed to a colony of Cormorants breeding there, but an exact examination of the food of some of these birds showed that this was not correct, as they fed mainly on fish which destroyed the ova of the Trout, and they were therefore beneficial. In Cornwall a few years ago there was a complaint that the Grey Seal (*Halichærus grypus*) was damaging the sea-fishing, and permission was given for a number to be destroyed. But unfortunately the bodies, and therefore the food, were not recovered for examination so a great opportunity was lost.

Rats are much in the news these days owing to the harm they do, and it will be interesting to speculate as to what might happen if their numbers were very greatly reduced. It seems likely that there would be a considerable increase in Mice in the towns, and of Mice and Voles in the country, which would occupy the burrows, etc., left vacant. Control measures would then have to be transferred to the smaller animals.

The above give some insight into the complications of animal life and show how active steps for or against some particular animal may have repercussions in other directions, and this aspect should be considered in any scheme of artificial control.

Such control would be prominent in the present plans and recommendations for the establishment of National Parks and Reserves of several kinds in this country. The object would be to preserve for all time certain areas which might be, as Amenity Reserves, accessible for enjoyment by the public and would be considered merely from the scenic standpoint. Others, such as Nature Reserves, would be for the preservation of particular plants or animals. Geological Monuments would consist of classic exposures which might be destroyed by quarrying, etc. National Parks would be much larger but, in this small country, far fewer and, while in the main open to the public, certain areas within them might have to be restricted at some seasons of the year. Obviously, some of these areas might serve more than one purpose, but in all these some scientific authority should be set up to work out the most suitable way in which such control should be carried out.

Recommendations for the counties of Gloucester, Somerset and Wilts are being sent up to the Nature Reserves Investigation Committee

in London. It is an attractive scheme, from the Naturalists' standpoint, and does not, in the writer's opinion, necessarily imply at all that all these areas are to be acquired by the State. The National Trust has shown that this is not necessary, and it is hoped that some adequate scheme may be worked out by which useful preservation would be carried out and much valuable information would be obtained.

Bristol Botany in 1943

By CECIL I. SANDWITH

(Received, March 14, 1944. Read in title, March 2, 1944)

ANOTHER year of War and a mild winter with little frost and no snow! Fortunately the weather is beyond control, and no doubt the Supreme Dictator has planned.

In spite of a cold May with frosts and gales, the year 1943 produced good crops although the apples seem to have suffered and were not abundant here. Many did not reach maturity, and many rotted on the trees. The aspect of the countryside has been somewhat changed by war needs, waving corn, with the accompanying cornfield weeds, red Poppies, Corn Chamomile and others not commonly seen in this part of the district, taking the place of well known, green pastures.

The Ash trees flowered early and abundantly. There is a saying that winter frosts kill the grubs. Do they? The 'leather jackets' are very tough and seem to be there, even after a hard frost, when the ground is dug up. In a mild season the birds seem to feed well without ravaging the fruit buds. Frost is a useful fertilizer and saves much labour. Superstition still prevails in country places, and we learn that it is dangerous to transplant parsley, deadly to burn green Elms even if there is a shortage of coal, and asking for trouble if the blossoms of Blackthorn are brought into the house. The adventure of Life presents many problems and there is still much to learn.

Helleborus viridis L. var. *occidentalis* (Reut.) Druce. In abundance in Cleaver's Wood near Norton St. Philip, S., F. K. Makins.

Viola lactea Sm. × *Riviniana* Rehb. Mr. S. M. Walters, who has visited the locality for *V. lactea* on Yate Lower Common, G. (see *Journ. Bot.* 1917, 227), writes as follows: "The well-known locality—field by the Midland Ry., 1 mile E. of Rangeworthy—was visited on May 28, 1943, and quantities of *V. lactea* and the sterile hybrid with *V. Riviniana* were seen. Actually, there seem to be very few plants in the field itself, but on the railway

cutting bank they are growing luxuriantly over c. 50 yds. The hybrid, which is clearly intermediate between *lactea* and the tall form of *Riviniana* which is abundant there, is of robust growth, forming patches up to 1 sq. yd. in area by vegetative growth. It is apparently a good deal more abundant than the *lactea* parent. The plants appear to be completely sterile, the open (May) flowers withering away in marked contrast to those on the *lactea* plants, where the sepals remained green when the corolla had withered around the developing ovary. In cultivated specimens, *lactea* set abundant seed from open and from the later cleistogamous flowers, whilst the hybrid flowers, open or cleistogamous, came to nothing. The interesting question arises as to whether *lactea* is losing ground in this locality owing to the prevalence of *Riviniana* pollen for fertilisation and the consequent production of sterile but robust hybrids, well adapted to the habitat. It may be that the destruction of the original heath localities for *lactea* has so reduced the population that hybridisation with *Riviniana* can cause the gradual extinction of the species.

“Two plants were noted which showed by their leaf characters (no flowers were available) probable *canina* origin. One has proved to be fertile (from cleistogamous flowers) and may be *V. canina* var. *ericetorum*; the other, apparently sterile, may be a *lactea* × *canina* hybrid. Both are recorded from the district (although there seems to be considerable confusion in the older records).”

Vicia angustifolia (L.) Reichb. A quantity of the form with nearly pure white corollas (the claws of the petals and the back of the standard are very pale yellow) appeared in May, 1943, with the typical form on a limestone slope at Tickenham, S., where it had never before been noticed, *C. Sandwith*.

V. sepium L. var. *ochroleuca* Bast. Hedgerow near Winford, S., *S. M. Walters*.

Rubus rotundatus P. J. Müll. ex Genev. (*R. cariensis* of Rogers, not of Rip. and Genev. *R. altiarcuatus* Barton and Riddelsdell). Det. W. Watson. Side of Blackdown on Mendip, towards Tynning's Farm, S., July 1940, *J. P. M. Brennan* and *Rev. N. E. G. Cruttwell*. New to the district.

Epilobium hirsutum L. The form with white flowers occurs on a streamside near Chew Stoke, S., *S. M. Walters*.

Verbascum virgatum Stokes. Hillside on the north side of the mouth of Cheddar Gorge, S., *Mrs. Brenan*. Presumably introduced, as elsewhere in our district.

× *Mentha cordifolia* Opiz (*M. rotundifolia* Huds. × *spicata* L.). Waste ground at Weston, Bath, S., Sept. 1936, *J. P. M. Brenan*. Confirmed by Mr. A. L. Still.

M. alopecuroides Hull and × *M. cardiaca* Baker were collected in 1935-36 in the old quarry at Twerton, S., by *J. P. M. Brenan*; determined by Mr. A. L. Still.

Gymnadenia conopsea (L.) R. Br. With pure white flowers on the peat moor, Shapwick, S., *Dr. W. Watson*. The albino has also been recorded from Mells, 1906, *G. B. Milne-Redhead*; and was gathered by *C. and N. Sandwith* near Charterhouse-on-Mendip, in 1936.

Epipactis palustris (L.) Crantz. Peat moor, Shapwick, S., *Commander Graham*. The first record of this species from the moors. It is remarkable that so conspicuous and well-known a plant has remained for so long undetected there.

ALIENS. *Impatiens parviflora* DC. Bourton Combe, S., *I. W. Evans*. *Cynosurus echinatus* L. On rubble on the bombed area around St. Nicholas' Church, Bristol Bridge, G., *I. W. Evans*.

Polygonum polystachum Wall. ex Meissn. A shrubby, autumn-flowering species from the Himalayas, with very attractive white flowers in terminal paniculate spikes. Established among brambles and bushes by the Channel near Ladye Bay, Clevedon, S., *C. and N. Sandwith*.

HEPATICS. *Aneura major* (Lindb.) K. Müll. Track in woodland at Tickenham, S., *C. Sandwith*.

Blasia pusilla L. Peat moor near Meare, S., Sept. 1942, *C. Sandwith*. New to N. Somerset, v.c. 6.

Madotheca Thuja (Dicks) Dum. On rocks, Clifton Down, West Glos., v.c. 34, *C. and N. Sandwith*. A first record for Gloucestershire.

LICHENS. *Parmelia conspersa* Ach. forma *isidiata* Leight. *Dr. W. Watson* writes that he recently noticed this form, which is new to Gloucestershire; on stones near the Suspension Bridge, Clifton, G. The typical plant is known from both East and West Gloucestershire.

Ornithological Notes, Bristol District, 1943

By H. H. DAVIS, M.B.O.U.

(Received, Jan. 20, 1944. Read in title, March 2, 1944)

AS in the previous three years, opportunities for regular bird-watching in 1943 have been few. A number of visits were, however, made to the North Somerset reservoirs and in particular to Blagdon where, from late January to early March, such unusual species as Crossbill, Wood-Lark, Scaup, Long-tailed Duck and Goosander were met with. Cheddar was visited twice, but, apart from a Greenshank in May, without any noteworthy results, while the only record of special interest from Barrow Gurney is that of a Temminck's Stint which stayed for at least a week in September.

Observations on the Severn mud-flats have shown that a few Knots and Sanderlings were present on both passages, and that several Curlew-Sandpipers and as many as fifteen Little Stints were among the large numbers of Dunlin and Ringed Plover early in September. Although the Little Stint is probably a fairly regular autumn visitor to the Severn Estuary its occurrence in such a number must be considered quite exceptional.

Records of special note for other parts of the district include those of a Hooded Crow near Bathford in December, a Waxwing on Clifton Downs and Black Redstarts at Uphill, both in October, and a Wood-Sandpiper near St. Catherine, Batheaston, in August. Hobbies were seen at Little Stoke in August and at Dyrham in September, while, in December, White-fronted Geese were identified overhead near Stoke Gifford and one was obtained near Nailsea. Quail may have bred in the Marshfield area where the characteristic call was heard on two occasions in the second half of June.

The more important notes for the year are listed below and are, except where otherwise stated, the result of observations by the following members of the B.N.S. Ornithological Section—A. E. Billett, Rev. F. L. Blathwayt, H. H. Davis, R. P. Gait, A. C. Leach, F/Lt. W. D. Melliush, G. Mogg, H. W. Neal, R. Poulding, J. H. Savory, D. M. Skinner, R. A. Skinner and H. Tetley.

HOODED CROW (*Corvus c. cornix*). One was seen from a train on

the west side of Bathford on December 1. The only records for the previous thirty years are those of single birds near Kingston Seymour in December, 1917, at Stoke Gifford about 1920 and at Winscombe on October 25, 1941.

CROSSBILL (*Loxia c. curvirostra*). What was quite evidently a small party of Crossbills was noted in flight on the south side of Blagdon reservoir on January 26. They were still present on February 2 when thirteen were counted in a larch spinney near the fishing lodge. At least four or five were red birds.

CIRL BUNTING (*Emberiza c. cirrus*). Three pairs were found nesting in the Uphill and Hutton area from mid-June to late July. Noted on the Gloucestershire side of the City as follows—a pair at Severn Beach, February 25; two males on Clifton Downs, March 21 and later; a female at Westbury-on-Trym, June 7; a male at Brentry on June 20 and August 5, and a male near Henbury on September 5.

TREE-SPARROW (*Passer m. montanus*). A few were present at Stoke Gifford in January and again from October to December. A single bird was seen at Morton, near Thornbury, on October 10, and up to thirty, or more, between Dyrham and Doynton from early October to the end of the year.

WOOD-LARK (*Lullula a. arborea*). Two were heard and seen overhead at Blagdon on January 26. At least two pairs bred on Bleadon Hill where a nest with young was found on March 28 and a second with eggs on April 11.

GREY WAGTAIL (*Motacilla c. cinerea*). A bird seen in the centre of the City on December 2 was frequenting the "blitzed" débris adjoining Wine Street.

RED-BACKED SHRIKE (*Lanius c. collurio*). A pair was found breeding near Stoke Gifford on June 11 and another at Patchway on July 4. As the use of feathers as nesting material by this species is considered to be most exceptional, the nest of one of these pairs was of particular interest in that feathers were loosely woven in all round the rim, giving it an unusually large and untidy appearance. A detailed examination of the nest after the young had flown showed that not only were feathers present in considerable numbers throughout but that they formed the greater part of the material used. A ready supply in poultry runs on a nearby building estate was, no doubt, the reason for the birds using feathers so extensively (cf. *British Birds*, Vol. XXXVII, pp. 114 and 155).

WAXWING (*Bombycilla g. garrulus*). A brief view was obtained of what was evidently a Waxwing in an ash tree near the Clifton Observatory on October 30. The bird, described as resembling a Hawfinch in size and having a conspicuous crest, was seen at fairly close range. Other field characters noted were the generally brownish coloration, the black chin and the yellow edges of the primaries. There is apparently no previous record for the Gloucestershire side of the City.

SPOTTED FLYCATCHER (*Muscicapa s. striata*). In the 1941 issue of the *Proceedings* it was shown that, although one of a nesting pair in a garden at Little Stoke disappeared while incubation was still in progress, the remaining bird continued to incubate and successfully hatched and reared the young. As it is usually assumed that, with most species, two birds are necessary to rear a brood, the matter seemed to be of some interest and, as the breeding site is an annual one, close watch was kept in subsequent seasons for any similar event. Observations in 1942 showed that two broods were reared, the same nest being used on each occasion and both parents being present throughout. In 1943 the birds were building late in May and incubation started on, or about, June 3. From then onwards little was seen of the second bird of the pair and it was certainly not present during the last seven days of incubation, nor at any time afterwards. The remaining bird carried on and, as in 1941, hatched and reared the young (four). While it may reasonably be supposed that one of the pair met an untimely end, there was no evidence of this and it seems unlikely that such would occur twice in three seasons in the same garden. It may, indeed, be suggested that in both instances it was a case of desertion on the part of the missing bird, and an intensive study of the Spotted Flycatcher would perhaps show that desertion (presumably by the male) does sometimes take place, even during the period of incubation.

CHIFFCHAFF (*Phylloscopus c. collybita*). What may have been a wintering bird was heard in a Fishponds Road garden on February 20 and again on the 23rd.

WILLOW-WARBLER (*Phylloscopus t. trochilus*). Spring arrivals were noted unusually early. One was heard at Winterbourne Down on March 24 (*The Times*) and one at Little Stoke on the 26th.

GRASSHOPPER-WARBLER (*Locustella n. naevia*). One was heard, and seen, in undergrowth on the Gloucestershire side of Banner Down on April 20. Also heard on the same day on Kenn Moor, Nailsea.

A nest with six eggs was found at Blagdon reservoir on May 16. Observations on the 30th showed that the nest contained four young.

REDSTART (*Phoenicurus ph. phoenicurus*). Probably breeds over a wide area of the Severn Vale. A pair, obviously nesting, was seen at Awkley, near Tockington, on June 8. On the 14th a brood of fledged young was noted at Littleton-on-Severn and on the same date a male, undoubtedly one of a breeding pair, was seen near Elberton (cf. also *Proc. B.N.S.*, 1941, p. 295).

BLACK REDSTART (*Phoenicurus ochrurus gibraltariensis*). Two immature birds were frequenting a quarry at Uphill on October 17. Both were still there on the 24th.

DIPPER (*Cinclus e. gularis*). Two (one carrying nesting material) were watched along the Little Avon, near Tortworth, on April 10.

LESSER SPOTTED WOODPECKER (*Dryobates minor comminutus*). A pair was noted on Bedminster Down on April 4 and a single bird at Henbury on August 15. Heard, or seen, at Little Stoke on various dates, and in all months, from July to December.

SHORT-EARED OWL (*Asio f. flammeus*). One was seen along the River Axe at Uphill on October 17.

PEREGRINE FALCON (*Falco p. peregrinus*). A pair was present in the Avon Gorge on February 16. One was identified overhead at Stoke Gifford on August 3.

HOBBY (*Falco s. subbuteo*). One (sometimes two) repeatedly noted at Little Stoke from August 17 to the 25th. A good view was obtained of two overhead at Dyrham Rectory on September 7.

COMMON BUZZARD (*Buteo b. buteo*). Again reported from the Brentry district. One was seen on two dates in March, and one (perhaps the same) on August 24. Also seen (single bird) at Shipham, near Cheddar, on April 22.

COMMON HERON (*Ardea c. cinerea*). Eighteen nests were found to be occupied at Brockley Combe on May 2. Banwell was visited as early in the season as March 14 when twenty-five nests were found to be in use. There was no later opportunity of visiting this Heronry.

WHITE-FRONTED GOOSE (*Anser a. albifrons*). Some, and probably all, of a flock of about sixty geese seen overhead near Stoke Gifford on December 18 were, by their highly pitched call-notes, clearly referable to this species. An immature bird was shot from a flock of about fifteen geese at Kenn Moor, Nailsea, on December 26.

SHELD-DUCK (*Tadorna tadorna*). Four were noted at Blagdon reservoir on March 7.

PINTAIL (*Anas a. acuta*). Seen at Blagdon as follows—six on January 26, two on February 2 and six on March 7.

SCAUP (*Aythya m. marila*). One, evidently an immature male, was present at Blagdon reservoir on January 26 and February 2. This is the first recorded occurrence of this species at Blagdon for nearly twenty years.

GOLDENEYE (*Bucephala c. clangula*). Between fifteen and twenty were counted at Blagdon on January 26.

LONG-TAILED DUCK (*Clangula hyemalis*). One, a female or immature bird, frequenting the Butcombe end of Blagdon reservoir on January 26, was still present on February 2. For previous records of this species at Blagdon cf. *Reports on Somerset Birds*, 1929, p. 37, and 1932, p. 13.

GOOSANDER (*Mergus m. merganser*). Five, a male and four "red-heads," were seen at Blagdon on March 7. Previous records for this reservoir are very few.

SMEW (*Mergus albellus*). Up to fifteen, including one adult male, were seen at Blagdon on January 26 and February 2. Several, including the adult male, were still present on February 7. Two "red-heads" were noted in the same place on March 7.

BLACK-NECKED GREBE (*Podiceps n. nigricollis*). Two were present at Blagdon on January 26 and February 2, and three on September 19. Single birds were seen at Barrow Gurney on September 12 and 26.

LITTLE GREBE (*Podiceps r. ruficollis*). Unusually plentiful at the reservoirs in September. Between twenty and twenty-five were counted at Barrow Gurney on the 12th, and fifty at Blagdon on the 19th.

STOCK-DOVE (*Columba ænas*). A pair was found breeding in an old Magpies' nest at Little Stoke Farm early in May. The nest contained two eggs on the 4th, but as it was found to be empty a few days later, no further observations were possible.

WHIMBREL (*Numenius ph. phæopus*). On May 20 two were seen in a field adjoining Cheddar reservoir where, according to the keeper, five or six had been feeding for the previous fortnight.

WOODCOCK (*Scolopax rusticola*). One was caught by a spaniel in Dyrham Wood on January 28 and one was shot at Marshfield a few days earlier. Another was put up in Dyrham Wood on December 3.

JACK SNIPE (*Lymnocyptes minimus*). Two were flushed from marshy ground adjoining Dyrham Wood on December 13.

KNOT (*Calidris c. canutus*). An adult sent to the Bristol Museum was found dead at Uphill on February 5. Two were seen on the mud-flats below Severn Beach on May 16, and one, in breeding plumage, in the same place on the 19th. A few were noted below Severn Beach on various dates from late August to early October—the largest number being about twenty on September 18. Of these, one was still showing traces of the rufous plumage.

CURLEW-SANDPIPER (*Calidris testacea*). One seen on the mud-flats between Avonmouth and Severn Beach on August 22 provides the earliest autumn record for the district. Three were observed in the same place on September 5.

LITTLE STINT (*Calidris minuta*). No fewer than fifteen were seen on the mud-flats below Severn Beach on September 5 (cf. *British Birds*, Vol. XXXVII, p. 139).

TEMMINCK'S STINT (*Calidris temmincki*). Close views were obtained of one at Barrow Gurney on September 12. The bird, observed at close range, was feeding at the water's edge at the west end of the large (No. 3) reservoir and was still in the same place on the 19th (cf. *British Birds*, Vol. XXXVII, p. 137). There is only one previous record for the North Somerset reservoirs (cf. *Proc. B.N.S.*, 1939, p. 31).

SANDERLING (*Crocethia alba*). Twice met with on the mud below Severn Beach in May—eight on the 16th and five on the 19th. Six were noted in the same place on August 22. One was observed at Blagdon reservoir on September 6.

WOOD-SANDPIPER (*Tringa glareola*). One was clearly identified near St. Catherine, at the southern end of the Cotswolds, on August 13. The bird, viewed at about ten yards range, was feeding at a small pond close to the Oakford reservoir and just within the County of Gloucester. It was noted as being smaller than a Green Sandpiper and when in flight lacked the black and white appearance of that species. Among other details observed were the brown mantle patterned with white markings, the white rump and barred tail. When flushed it gave a shrill triple call, all on the same pitch. This appears to be the first recorded occurrence for South Gloucestershire.

GREEN SANDPIPER (*Tringa ochropus*). Seen on two occasions at the reservoirs—a single bird at Barrow Gurney on September 12

and three at Blagdon on the 19th. One was seen, and heard, overhead near Stoke Gifford on December 1.

COMMON REDSHANK (*Tringa totanus*). Large numbers, probably not less than 300, were frequenting the River Axe at Uphill on October 17.

GREENSHANK (*Tringa nebularia*). The following were reported from the North Somerset reservoirs—one at Cheddar on May 20 and 22, one at Blagdon on September 6 and 19, and one at Barrow Gurney on September 12 and 19.

RINGED PLOVER (*Charadrius hiaticula*). Of 150 examined at close quarters on the river bank below Severn Beach on October 3, all but three or four were immature birds.

GOLDEN PLOVER (*Pluvialis apricaria*). About half a dozen were associating with Lapwings on flooded pastures at Stoke Gifford on January 10.

GREY PLOVER (*Squatarola squatarola*). Five were seen on the Avonmouth-Severn Beach mud-flats on September 12.

BLACK TERN (*Chlidonias n. niger*). What appears to be the only record for the year is that of an adult hawking over Blagdon reservoir on September 6.

WATER-RAIL (*Rallus a. aquaticus*). One was picked up dead in the roadway adjoining Barrow Gurney reservoirs on September 12. By an extraordinary coincidence, another was found dead within a yard or two of the same spot on November 7. Both had probably been killed by striking overhead wires. A Water-Rail was seen in a ditch near Dyrham on December 5.

RED-LEGGED PARTRIDGE (*Alectoris r. rufa*). A single bird was heard and seen at Little Stoke on June 12. In October a covey of five was seen on arable land at Colerne (near Marshfield), a short distance beyond the Glos.-Wilts. boundary.

QUAIL (*Coturnix c. coturnix*). The "whit-whi-whit" call was noted on two occasions on the north side of Marshfield in June—a bird being heard in a clover crop at Downtorns Farm on the 17th and another at Shire Hill, just over the Glos.-Wilts. boundary, on the 22nd.

Regularity in Migration of Swifts

By H. TETLEY, M.B.O.U.

(Received, Feb. 1, 1944. Read in title, March 2, 1944)

SEASONAL regularity in migration of the summer migrants visiting this country is a well-recognised feature and the writer has had an opportunity of testing it in the Swift (*Apus a. apus*). These birds, coming from Africa, are one of the latest to arrive, and the earliest to leave, and some of them breed each year under the roof of a house opposite the writer's in the Stoke Bishop area and, whenever possible, dates of their arrival and departure have been kept from 1933 to 1943 inclusive, full dates being available for seven of these years. The Swifts, on arrival and throughout their stay, wheel and scream low over the roof-tops or between the houses so that their presence is easily noted. The results of these observations have been as follows:—

Year	Arrival	Departure	Length of stay
1935	4 May	8 August	96 days
1936	6 „	9 „	95 „
1937	3 „	6 „	95 „
1938	8 „	5 „	89 „
1941	9 „	6 „	89 „
1942	6 „	5 „	91 „
1943	12 „	14 „	94 „

If the 1943 date is excluded, this gives a range of only 6 days for arrival and of 4 days for departure, but even if it is included, the range is only extended to 9 days in each case. The length of stay in this particular area varied as little as 7 days, including all dates, and it is particularly noticeable that though the arrival in 1943 was much the latest recorded so was the date of departure, so that the period of their stay here came well within the normal figures. It may also be recorded that, in eight recordings of the time of arrival, i.e. when the birds were first noted, in every case this was in the evening between 6.30 p.m. and 9.0 p.m.

Swifts feed entirely on insects, and mainly on Diptera, so that their departure at a time when such food is plentiful cannot be attributed to any lack of supply.

The above data will afford some further proof of the great regularity of migration which is sufficient to overcome normal weather conditions. The winter of 1942-43 was in this country particularly mild so that there was doubtless plenty of food available some time before the Swifts actually arrived, but as the same conditions seem to have prevailed in Western Europe, an ample food-supply en route may have been responsible for their late arrival. Yet their length of stay was normal and it seems quite evident that this is yet another example of an inherent regular impulse governing the migrating movement of these birds.

Gondwanaland, a Former Southern Continent

By SIR LEWIS L. FERMOR, O.B.E., D.Sc., F.R.S.

(Lecture given on March 25, 1943, at the General Meeting of the Society)

SOME 90 years ago there was a young recruit to the recently formed Geological Survey of India, named William Thomas Blanford, destined to achieve fame both as geologist and zoologist. He was early sent to make an original geological survey of a part of Orissa, a country of primitive, feudatory states lying to the south-west of Calcutta.

In this region there is a stratified series of sedimentary rocks—sandstones and shales, with coal beds—overlying the old Archæan gneisses and schists, a tract of sedimentary rocks later termed the Talcher coalfield after the Indian State of that name. At and near the base of this sedimentary series is a peculiar conglomerate or boulder-bed composed of rounded boulders and pebbles, often of large size, set in and scattered through a very fine-grained matrix indurated to a shale.

Now it is very difficult to explain the association of these large boulders with the matrix of shale, originally clay you must remember, in which they are set. A stream or river with a current strong enough to carry along and deposit these boulders would wash away the fine silt, whilst a stream gentle enough to allow the settling of very fine clay could not possibly move the boulders.

Blanford, to overcome this difficulty, conceived the idea of transportation by ice, in spite of the fact that he was working in a tropical climate where a really cold winter was quite unknown. The possibilities were floating ice transporting boulders into silt-charged water fed from glaciers, the boulder being dropped into the fine silt as the floating ice melted; or ground ice moving slowly over a rocky basement, grinding the rock into powder, and facetting and rounding boulders and pebbles embedded in the base of the ice.

Blanford's suggestion that ice had played a part in the formation of this peculiar deposit received confirmation from two facts. Some of the pebbles were found to be facetted as well as rounded, as would happen when a stone embedded in the bottom of moving ice was turned over and another face ground on it; in addition, the pebbles often showed scratches such as would be produced during such grinding.

The second fact was the discovery in the banks of the Penganga River in Hyderabad State, in the very hottest part of the centre of India, of a similar boulder bed resting directly on a scratched pavement, such as could only be explained as due to moving ice armed with the abrasive power of stones and boulders, and such as could be matched in glaciated regions in many parts of the northern hemisphere.

Above this Talcher, glacial boulder-bed occurs in many parts of Peninsular India a thick succession of sandstones and shales with coal beds and fossil plants, and in certain strata large fossil reptiles. It is beyond doubt that this succession of beds, which reaches a total thickness of several thousand feet and ranges in age from Upper Carboniferous to Jurassic or even Cretaceous, was deposited mainly under freshwater conditions.

This formation is specially well represented in the Central Provinces of India, and was in consequence named the Gondwana formation after the former Gondwana kingdom that existed when the so-called aboriginal Dravidian race known as the Gonds ruled in this part of India. Amongst the fossil plants of the Gondwana beds were some peculiar fern-like plants of which the most important is the fossil genus *Glossopteris*: consequently this flora is usually known as the *Glossopteris* flora.

Meanwhile a similar series of sandstones and shales with coal beds, a *Glossopteris* flora, and fossil reptiles, and with a similar boulder-bed at or near the base, sometimes with an underlying ice-scratched pavement, was being discovered in South Africa, Australia, and South America. It thus became evident that there must once have been a continent connecting these now widely separated countries; and to this continent it has become customary to apply the term *Gondwanaland*. Further, it is evident that this continent must have persisted, like the Gondwana formation, through several geological periods, namely from the Carboniferous up into the Jurassic, and perhaps into the Cretaceous.

Also it is evident from the fossil remains of plants and animals that the conditions of life in Gondwanaland were very different from those in North America, Europe, and most of Asia—a part of the world that geologists sometimes call Laurasia, in contrast to Gondwanaland. It was warm in Laurasia when there was an ice age in Gondwanaland, and Gondwanaland remained a land area continuously through several geological periods whilst much of Laurasia was being subjected periodically to marine conditions with submergence caused by folding move-

ments leading ultimately to mountain formation. Marine fossils were being entombed in Laurasia whilst large reptiles were roaming on land in Gondwanaland. The geological formations of Laurasia were subjected to periodic compressive folding movements with intense folding of the rocks and with mountain-building operations, whilst Gondwanaland remained a land area relatively free from the effects of earth movements.

But if we look at a map of the world we see that Gondwanaland is now represented by separate fragments, some of which are in the tropics, *e.g.* much of the Indian Peninsula and Central Africa; whilst other portions are in cold regions such as southern South America and Antarctica, for the latter has been found also to be a part of Gondwanaland. What has happened?

A former explanation was that the position of the axis of the earth had been altered and that one of the poles was once in the midst of Gondwanaland. However, no one has been able to provide a convincing explanation of the process by which the position of the poles could be altered so widely, and it is no longer necessary to give serious consideration to this hypothesis.

The fact is that Gondwanaland has been broken up. How has this happened? Have once-intervening portions of the earth's crust foundered and sunk below the oceans, for example between South America and Africa, or between Africa and India? Or do the existing fragments represent most of Gondwanaland, and owe their separateness to floating apart, not of course on water, but on a liquid or plastic, or potentially liquid, substratum of the earth's crust?

It is very difficult to propound any satisfactory explanation of foundering on the vast scale that the former hypothesis would need. There was no vacuum below the crust of the earth into which portions of the crust could sink. Also, there is no obvious reason why large and capriciously distributed tracts of the earth's sub-crust should have suddenly become compressible into much denser rock so as to permit the foundering of the overlying crust to a depth of some thousands of feet, in places miles, below the sea level.

On the other hand, if we reject the idea of foundering or sinking of large portions of the earth's crust, how can we support instead such an apparently ridiculous idea as the floating apart of the continents to distances of thousands of miles? This verbal antithesis is of course only a play on words, for by floating we do not mean floating on water, but instead, as already mentioned, floating on a liquid or

plastic, or potentially plastic, sub-stratum, at a very slow rate, which if carried on for long periods of years—millions of years—would produce the vast separation of the fragments we now see.

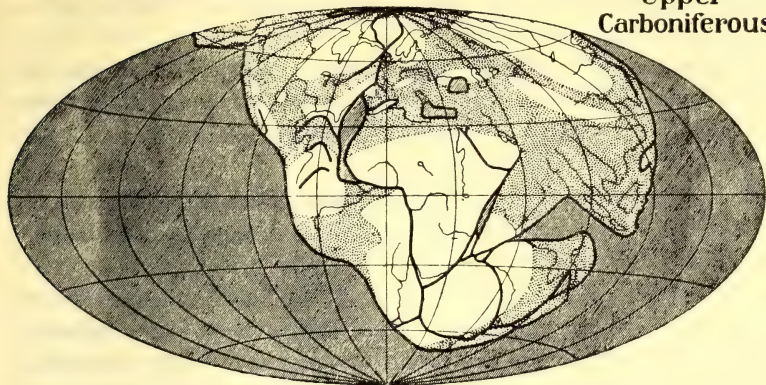
The older school of geologists naturally views with favour the hypothesis of foundering: the modern school tends to favour the view that Gondwanaland has been broken up by flotation or continental drift. Although there is abundant evidence of the rise and fall of land tracts throughout the ages, these changes, admitted by all geologists, are not on the grand scale that would be required to explain the break-up of Gondwanaland by foundering. The well-recognized changes of level are usually related to changes connected with the formation of fold mountains such as the Alps or the Himalaya, which are characteristic of so much of Laurasia, changes of a type absent from Gondwanaland on any important scale since Carboniferous times, except on its margins, *e.g.* where the Himalaya impinge on the edge of Gondwanaland. Or they may be changes of level consisting of block uplift or depression of a type found both in Laurasia and Gondwanaland, and on too small a scale to be difficult of explanation.

But whilst I am prepared to accept the possibility, even the probability, that there may have been local foundering of small portions of Gondwanaland, I find it impossible to accept as a reasonable proposition the foundering of former continental tracts over the whole of the Indian Ocean and the whole of the South Atlantic Ocean, as the foundation hypothesis requires.

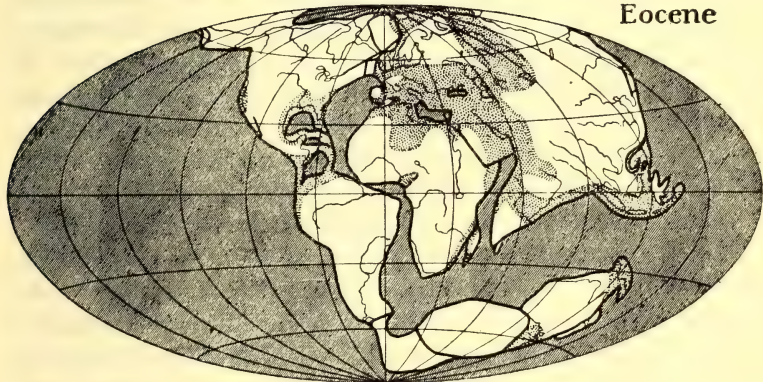
Let us turn, therefore, to the other hypothesis, the hypothesis of continental drift. This is the later hypothesis, but one with a growing number of adherents; for it is much easier to accept as a fact, even if one does not probe into cause and mechanism. In fact, in lectures to schools, I have found it easy to expound as a remote cause of the history of the British Empire!

Let us look at the map of the world. You will see that if you took a pair of scissors and cut out South America and Africa they could be fitted roughly together so that the eastern corner of Brazil in South America fits into the Gulf of Guinea in Africa, and the east coast of South America laps alongside the west coast of Africa, the Cape of Good Hope coming against Argentina. It is easy to suppose, therefore, that these two continents were once joined and have since moved apart. It is possible also to treat India, Australia, and Antarctica as additional parts of a jigsaw puzzle and move them into place, as has been done in figure 10, which shows the whole of the world's present land surface

Upper
Carboniferous



Eocene



Older Quaternary

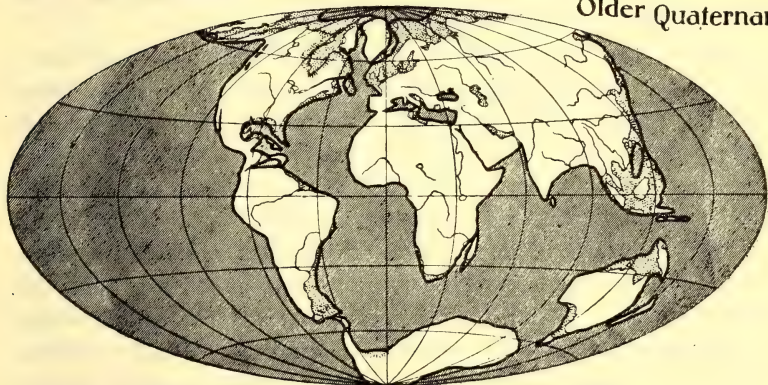


FIG. 10

RECONSTRUCTION OF THE MAP OF THE WORLD SHOWING THE BREAK-UP OF PANGÆA
(From Seward's *Geology for Everyman*, Cambridge University Press, after Wegener's
Origin of Continents and Oceans, Methuen.)

collected together into one land-mass (Pangæa), the southern portion of which is Gondwanaland.

The possibility of thus collecting together, on paper, the whole of the land surface of the earth reminds us that three-quarters of the surface of the globe is occupied by water and only one-quarter by land. Can we explain why?

In 1879 Sir George Darwin, son of Charles Darwin, propounded the hypothesis that the moon was once a portion of the earth and had left the earth owing to tidal causes.

This hypothesis, which has a mathematical basis, has gained general acceptance in astronomical circles; and as there is nothing in Darwin's hypothesis requiring that this departure must have taken place before the earth had acquired a solid crust, there are those who think it took place after. This latter view has been advanced by the Rev. Osmond Fisher in his *Physics of the Earth's Crust* published in 1881. He regards the Pacific Ocean as the scar left by the departure of the moon, this hypothesis requiring that three-quarters of the crust went up into the sky to form the moon, and that the remaining quarter broke up into larger and smaller fragments that floated towards the cavity from both sides, thus forming the Atlantic Ocean. The implications of Fisher's hypothesis were emphasized in 1907 by the American astronomer, Professor W. H. Pickering, who showed that the volume of the moon corresponds with that of a solid with a surface equal to that of all our terrestrial oceans, and a depth of 36 miles. We see now where the missing three-quarters of the earth's crust has gone, if the views of Darwin, Fisher, and Pickering are sound.

Later, F. B. Taylor (American) and A. Wegener (German) and a host of other investigators considered the implications of this problem of the movements of the continents. Wegener was allowed temporarily to steal the thunder of his predecessors, so that the hypothesis of continental drift became known by his name. If the name of anyone is to be associated with this hypothesis it should be called the *Fisher-Pickering hypothesis*. I, for example, knew about it before I had ever heard of Wegener and before his book on the subject had been published.

But it is better to call it the *theory of continental drift*, for the volume of evidence pointing to the truth of a wandering of the continents has become so thick that we have reached the point at which the word hypothesis can be discarded in favour of the word theory. The facts have recently been assembled and expounded with convincing clarity by Dr. A. L. Du Toit in his book *Our Wandering Continents*.

If we accept this theory, we do not need to move the poles ; we understand how it is that glacial boulder-beds and ice-scratched pavements have reached the tropics—namely by the slow wandering northwards of Peninsular India at some time after the Carboniferous glaciation. We understand why South America and Africa can be made to fit like two pieces of a jigsaw puzzle : and we can dispense with foundering on a colossal scale. Further, if we are prepared to accept the departure of the moon as the remote cause of the wandering, we can explain why three-quarters of the crust of the earth is missing and where it now is—namely in the moon.

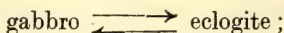
But we have not explained how the continents drifted, floated, or wandered—what was the mechanism. Unless we can do this, our speculations are on a flimsy basis and we are not justified in replacing the word hypothesis by the word theory.

Now, if we consult the geological map of the world, we notice that in certain tracts hundreds of thousands of square miles of the surface are occupied by sheets of basaltic lava that has reached the surface from below through long fissures and has flowed over the surface for long distances, evidently in a very fluid condition. Such large tracts exist in Peninsular India (200,000 square miles of Deccan Trap up to 6,000 feet thick), in the U.S.A. (in the north-western states of Idaho, Washington, and Dakota), and in the Arcto-Britannic Province (in the Hebrides, Iceland, etc.), all these huge spreads of basaltic lava being of late Cretaceous to Tertiary age. There have been other such vast floods of basaltic lava welling up through fissures in the crust at intervals throughout earth history and in every continent. These basaltic lavas of different ages and continents have a roughly similar chemical composition, as if they have all come from the same source ; so that it is evident that at some distance below the surface there must be a continuous shell or reservoir of material that, when it appears at the surface, solidifies as basalt.

The common rock basalt is composed mainly of three minerals, felspar, pyroxene, and iron-ore, with interstitial glass representing portions of the original magma that have not had time to crystallise during the quick cooling of the lava at the surface ; in addition, a fourth mineral, olivine, is sometimes present, as well as various hydrous minerals lining the cavities or steam holes in the lava. It does not follow that this rock was basalt down below ; for the *basaltic shell*, by which I mean the shell of the same chemical composition as basalt, extends to such a depth, say 30 to 40 miles, that the temperature and pressure

would be too great for rock of basaltic composition to exist either as basalt or as its completely crystallised plutonic form, gabbro. Instead, there are many reasons for supposing that at this depth, at least the lower portions of the basaltic shell must have been compressed by the weight of the superincumbent crust into a much denser rock rich in garnets and other dense minerals and known as eclogite. This remarkable rock, *eclogite*, has a density of 3.4 to 3.5 against the 2.9 to 3.0 of basalt and gabbro, so that it occupies some 14 per cent. less room than gabbro. There is, indeed, much reason for believing that the lower portion of the basaltic shell of the earth must be in the form of eclogite; to this shell I like to apply the term *infra-plutonic shell*. The reaction by which gabbro passes into eclogite must be an endothermic one, by which is meant a change accompanied by absorption of heat as well as reduction of volume. Conversely, the reaction eclogite to gabbro or basalt must be an exothermic one accompanied by increase of volume and evolution of heat.

I have not now at my disposal the time to discuss at length this fundamentally important reversible reaction



but elsewhere* I have shown that by its aid explanations can be given of the following phenomena:—

1. The fissure eruptions that give rise to the floods of basaltic lava already noticed.
2. Isostasy, or the balance of vertical prisms of the earth's crust of different densities and heights that enables the high mountain ranges, such as the Himalaya, to be supported.
3. Deep-focus earthquakes.
4. The flotation or drift of continents.
5. The formation of a special class of stony meteorites known as the chondritic meteorites.

It is only to the fourth of these that we need now direct our attention.

We were looking for a mechanism by which the continents could wander, for a layer upon which they could float and move, a layer with a fundamental ability to yield and permit, by its properties, large continental slabs of the crust, slowly but surely, to wander or drift.

The junction between the plutonic gabbroid shell of the earth's crust and the underlying infra-plutonic shell of eclogite cannot be at a uniform depth; instead, the depth of this junction must vary with

* Garnets and Their Role in Nature. *Indian Association for the Cultivation of Science*, Special Publication No. VI (1938).

the density of the overlying rocks, and be liable to alteration in position by the conversion of gabbro into eclogite or *vice versa* in a very hot region of the crust that must be at least potentially plastic; for with release of pressure, hot eclogite must pass into gabbro or to liquid basalt. It is this movable and, therefore, unstable junction that provides the plastic sole upon which the continents can wander.

The exact depth of the top of the eclogitic layer, the infra-plutonic shell, is not known; it is obviously variable, but enough is known from the study of earthquake data to enable us to say that the level of isostatic compensation lies at from 37 to 60 kilometres from the surface, and this, on my hypothesis, is also the eclogitic level. It seems to me very remarkable and significant that the higher of these two figures, namely 60 kilometres, should be so close to the figure of 36 miles or 57.6 kilometres taken by Pickering as the average thickness of the portions of the crust that departed to form the moon (Osmond Fisher calculated this figure as about 40 miles—64 kilometres, *loc. cit.*, 2nd Edition, p. 380).

Summarising, let us agree on the following points as at least reasonable deductions from the evidence:—

(1) There was once a great southern continent, which we now call Gondwanaland.

(2) The existing fragments thereof are most of South America, Africa, and Australia; the whole of the Peninsula of India and of Antarctica as far as this land mass is known.

(3) These fragments have drifted slowly to their present positions, so that in the case of India we now find, in a tropical climate, an ice-scratched pavement and rocks of glacial origin.

(4) The mechanism that rendered possible this continental drift was a sub-crustal, reversible, mineral change typified by the reversible reaction gabbro to eclogite taking place at some 23 to 36 miles below the surface.

With much less certainty we can say that

(5) The cause of the break-up of Gondwanaland was the loss of three-quarters of the crust to the moon, mainly from the side of the earth now occupied by the Pacific Ocean, which loss left a cavity towards which the remainder of the crust drifted from both sides, thus creating the Atlantic Ocean.

Those of you who are geologists will realise that the geological history of Gondwanaland is very different from that of the northern continent Laurasia, and that colleges and universities that teach

geology without Gondwanaland are omitting a large portion of the story.

Perhaps I should mention briefly one very important difference on the economic side between Gondwanaland and what may be termed Non-Gondwanaland. In Gondwanaland there is exposed at the surface a much larger proportion than in Non-Gondwanaland of the ancient Archæan formations that underlie the younger sedimentary strata, commonly fossiliferous, marine formations in Non-Gondwanaland, and freshwater formations in Gondwanaland. As a consequence, there is an unequal distribution between the two types of continent, Gondwanaland and Non-Gondwanaland, of the minerals of use to man.

This is illustrated by the fact (see Fig. 11) that five out of the seven most important sources of manganese-ore lie in Gondwanaland. In addition, 99.99 per cent. of the world's annual output of diamonds comes from Gondwanaland, and more than half the world's gold supply, whilst all the really deep gold mines are in Gondwanaland—in the Rand in South Africa, in the Kolar goldfield in India, and in the Saint John del Rey mine in Brazil. In each of these areas there is at least one gold mine now over 8,000 feet deep from the surface. As a striking example in the opposite direction we may notice that by far the largest proportion of the world's output of petroleum comes from Non-Gondwanaland.

In lectures to schools I have pointed out that if Gondwanaland had not been broken up, the whole history of the British Empire would have been different. There would have been no Cape of Good Hope for the Portuguese navigator Bartholomew Diaz to discover and round in 1487, and therefore no sea route for Vasco da Gama to India and Malaya and no British Raj in India.

And if we amuse ourselves by pursuing this speculation further back into the past, the whole of the earth's crust would still be here and there would be no moon and no moonshine !

It is this condensed mineral *garnet*, so characteristic of eclogite and other dense rocks, with its ability to break down into less dense aggregates of pyroxene and felspar, and *vice versa*, that renders possible and explains the reversible reaction gabbro to eclogite and has provided the mechanism for all these remarkable events.

I cannot now enlarge upon the role of garnet in Nature, as I have done elsewhere, but I hope that the next time you see a garnet you will no longer look upon it merely as a cheap, semi-precious though beautiful gemstone, but will realise that you are looking at one of the most remarkable products of Nature.

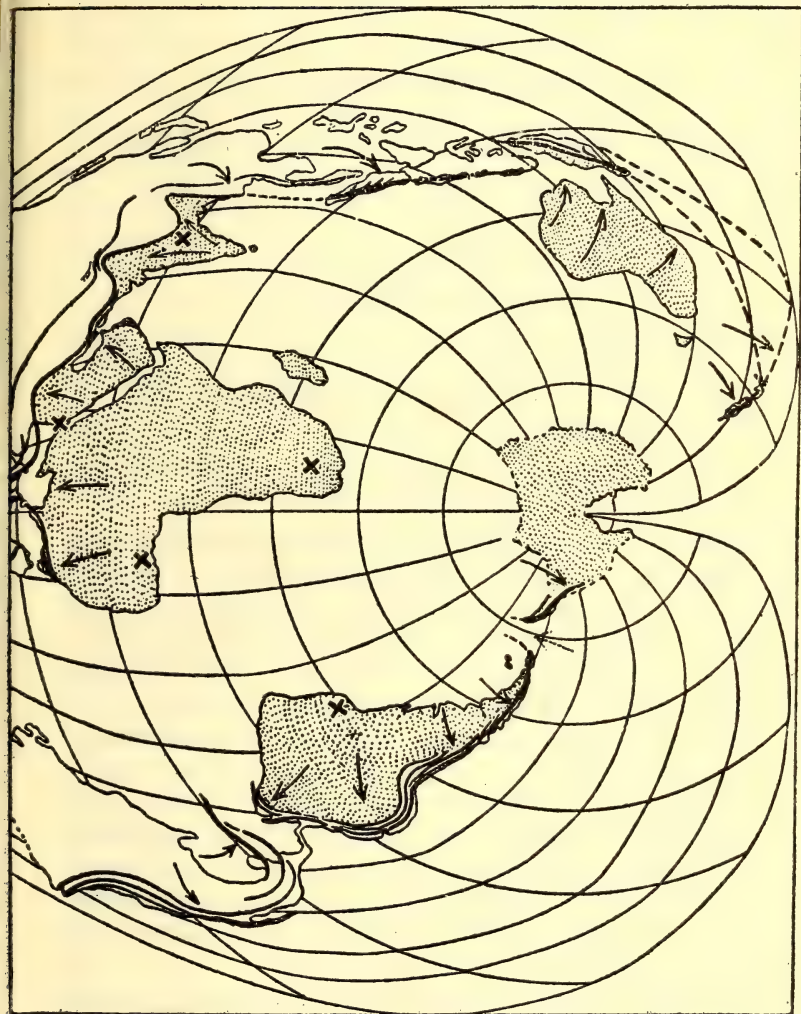


FIG. 11

GONDWANALAND, THE FRAGMENTS OF WHICH ARE INDICATED BY STIPPLING. The crosses mark the five principal manganese-ore tracts of Gondwanaland—Brazil, the Gold Coast, South Africa, Egypt (Sinai), and India.
(After Prof. A. Holmes, from *The Advancement of Science*, Vol. II, Part 7).

Studies on the Biology of the Bristol Channel

XV

THE SEVERN GEESE

By H. H. DAVIS, M.B.O.U., and H. TETLEY, B.Sc., M.B.O.U.

(Received, Jan. 20, 1944. Read in title, March 2, 1944)

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I. THE NEW GROUNDS : HISTORICAL

BETWEEN Slimbridge and the Severn and about four miles north of Berkeley are the highly fertile pastures known as the New Grounds¹ which, together with the adjoining saltings, have been for at least a hundred years the regular winter haunt of large numbers of wild geese. Although early histories contain no reference to them it seems likely that geese have wintered there for centuries.

This pasturage, for long forming part of the Berkeley Castle Estate, was at one time overflowed by the Severn, but as its name implies, has been gradually reclaimed and enclosed from the river. When such enclosure was finally completed is uncertain, but that the reclamation of considerable areas was in progress early in the seventeenth century is evident from MSS. by Smyth (1639), from which the following passages concerning what are referred to as the "newe warthe" and the "newe gotten grounds" may be cited:—

"In the last 10 or 12 yeares, are 300 acres . . . of sand heapes cast togeather at the lower end of the said new grounds, and leaft by another remove of the Channell in that part; which 3 yeares nowe last past began to beare weedes and grasse, And daily (by my Cribs and other

¹ At the present time many acres of the New Grounds are turned over to cultivation for potato and corn crops.

fortifications to preserve and better it) soe bettereth itselfe that it is more than likely to become in fewe yeares a fruitfull pasture."

"It was the 6th of September next after, a.^o 1637, before them and one John Taylor of Bristol . . . by a Jury at Newenham, presented; That a parcell of ground within the parish of Slimbridge called the Newe inclosed grounds, containinge by estimacon two hundred acres, adioyninge and abuttinge upon fframptons pill on the North, And upon the regall river of Severne on the west, and within 40 yeares then last, was slymy and muddy ground, and parcell of the great and comon regall river of Severne . . . and whereon the water of the said River . . . used to flowe and reflowe . . . And that within the said 40 yeares, the said 200 acres . . . became dry. And within 30 yeares last were inclosed and imbanked from the sea."

"And the said Jury then further presented, that one other parcell of land lyinge in the said parish, called the Dumballs, newe gayned grounds, containinge by estimacon thirty acres (indeed 300 acres) lyinge at the end or point of the newe warth, were within twenty yeares last slymy and muddy grounds, and parcell of the great and comon river and regall water of Severne and covered with the same. . . ."

That the great fertility of the Slimbridge pastures was recognised at a comparatively early date may be gathered from Fuller (1662) who says, "As for pasturage, I have heard it reported from credible persons that such is the fruitfulness of the land nigh Slimbridge that in the springtime, let it be bit bare to the roots, a wand laid along therein over night will be covered with new grown grasse by the next morning." These remarks are carried a step further by Fosbrooke (1807) who records that "on this being told to King James I the incredulous King answered that he knew a field in Scotland where if a horse was turned in on a Sunday it would be in vain to look for him the next day."

The county historians Atkyns (1768) and Rudder (1779) both refer to the reclamation of this land and, evidently quoting from the Smyth MSS., mention a dispute over its initial ownership. The former states, under the heading of Slimbridge, that "Many hundreds of acres of very rich meadow in this parish, called the New Grounds, have been gained from the Severn and do belong to the Earl of Berkeley because his manors do extend to the middle of that river. A suit in the exchequer was begun in the reign of King Charles the First to entitle the crown to these lands; but after the jury was impanelled, and evidence begun, the attorney-general dropped the suit." This writer also records that "There is a large common in this parish called

The Warth : it consists of very rich ground and is sometimes overflowed by the Severn ; which if it were inclosed would be worth 1000£ yearly.” Rudder’s account, which is substantially the same, gives the information that the New Grounds extend to more than a thousand acres, that many cattle are pastured there and that the true Samphire¹ grows “in great plenty.” His remarks on the Warth differ only in saying that it would be worth £1500 a year were it enclosed.

The Warth, a continuation of the New Grounds, lies to the south of the New Decoy Pool² and closely adjoins the Gloucester and Berkeley Ship Canal (see Fig. 12). It now has, like the remainder of the pastures, the protection of a flood-bank. Fosbrooke (1807) mentions it as “a waste recovered from the Severn and lately enclosed”—a remark which, if compared with those of Atkyns and Rudder, suggests that its enclosure dates from about the beginning of the nineteenth century. In describing its history as being curious, Fosbrooke says that “a jury found, 18th Hen. III, that the river washed away the land at Slimbridge, first to Awre on the opposite side, and then rewashed it to Slimbridge.” Smyth, in his MSS, quotes the extraordinary finding of this jury in some detail and refers to a Record in the Tower of London as being the source of his information.

Such then are the accounts we have of the reclamation of this very fertile tract of land. The omission of any mention of wild geese is to be regretted, for there seems little reason to think that what is now so marked a feature of the district was not equally marked during the lives of at least some of these historians.

That geese were wintering on the New Grounds in 1843 is known from records noted on the spot and regularly sent to Berkeley Castle. As far as can be ascertained, however, the first detailed reference to the birds is that of Berkeley (1854) in which the writer states that “Immense flocks of wild geese are in the habit, from September to April, of feeding on some large grazing meadows by the side of the Severn, called the New Grounds . . .”, and further mentions that among the geese killed at Berkeley Castle are “four different species—the grey lag, the white-fronted goose, the bean-goose, and the pink-toed goose.” In view of what is known to occur at the present day, the same writer gives details of much interest when he says “There is . . . a very extraordinary change in the flocks of geese that haunt the

¹ *Crithmum maritimum*.

² The more recent of the two Berkeley Castle duck decoys which for many years were successfully worked by the decoymen Nicholls.

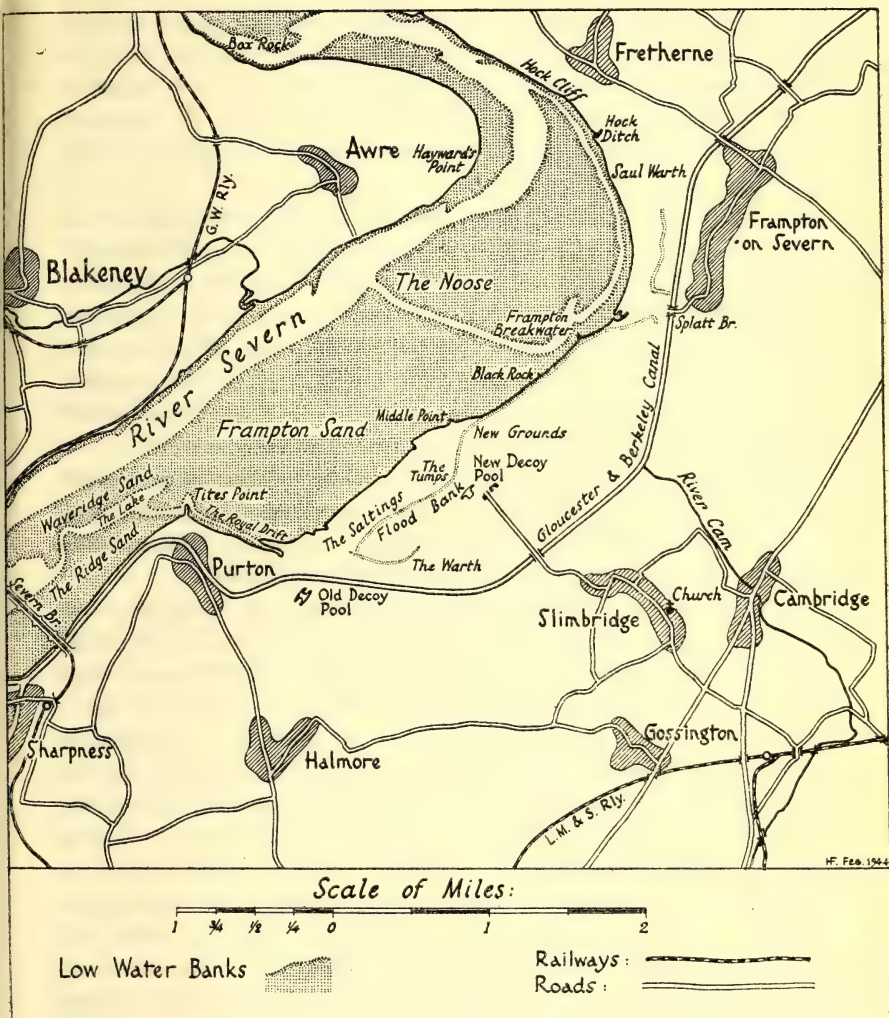


FIG. 12.
SKETCH MAP OF THE NEW GROUNDS AREA.

New Grounds at Berkeley Castle ; it is that at a period of the winter the species congregating there change. For instance, up to a given period . . . the flocks, with little exception, consist of the great grey goose¹ ; after that the grey geese almost entirely disappear and the White-fronted Goose fills their place. This change, though the geese are narrowly watched and a report of their numbers frequently returned to the Castle, is never seen to take place ; no flights are observed to come and go, but the flocks apparently remain stationary, though the grey goose leaves the ground."

In remarking on the numbers of geese, Berkeley (1854) states that "At times, and in hard weather, the geese number many thousands." The same author again refers to them as "exceeding occasionally ten thousand." Mellersh (1902) gives a comparatively moderate estimate, but in writing of the White-fronted Goose at a later date (1907) he also quotes numbers reaching ten thousand. The accuracy of these statements cannot now be assessed, but it may here be said that while ten thousand geese might well be accommodated on the New Grounds for a short while, it seems highly unlikely that so great a number could be maintained there for any length of time. The many observations of recent years suggest a maximum of from three thousand to four thousand—and that only occasionally.

Goose-shooting on the New Grounds has for many years been regarded as excellent sport. Both Berkeley (1865-66) and Gould (1873) refer to it, while Walsingham and Payne-Gallwey (1897) record that "The only other place we know of in our islands where wild geese are obtained with a shoulder-gun in such numbers as at Holkham is near Berkeley Castle, in Gloucestershire (Lord Fitzhardinge's), not far from the banks of the Severn. Here 45, and on another occasion 44, wild geese were killed in a day, the larger bag being obtained during the great snowstorm of 1881." Whitaker (1918), in writing of a visit to the Berkeley Castle decoys, gives a brief description of how the geese are driven over high butts between the meadows and the river, and adds that as many as 21 have been shot at one drive. That shooting, carried on almost annually for at least a century, has had no adverse effect on the numbers of geese visiting the New Grounds may be gathered from shooting bag records covering a period of ninety years.

¹ What is intended by the great grey goose is not clear. It at once suggests the Grey Lag, but as this species has for long been regarded as a scarce visitor to the Severn, and since the Pink-foot (a larger and rather paler bird than the White-front) has been known for almost fifty years as being the first goose to reach the New Grounds and the first to depart, it seems likely that the species in question was the Pink-foot.

These show the greatest number killed in one year to be 184 (in 1928) and the average annual bag to amount to no more than 40.

From records giving the arrival dates of the geese from 1843 onwards, it appears that, with one exception, the first to reach the New Grounds have arrived in the month of September. In no less than 69 of the 85 years listed, the arrival date has been from the 12th to the 23rd. It may thus be seen that they turn up with great regularity. Although very few data are available, it seems, from local information, that their final departure in the first half of March is also extremely regular. Notes received from F. J. Workman, the present decoy-keeper, give the average departure date for the five years 1939-43 as March 11.

Observations during the years 1932-43 show that, although they make fairly frequent visits in small numbers to other reaches of the river, the bulk of the geese may usually be found on the New Grounds where, under the direction of Capt. R. G. W. Berkeley, they receive adequate protection from outside interference. Their favourite haunt by day, and apparently by night, is the 200 acres of saltings outside the flood-bank, though they are often to be seen feeding in the enclosed meadows. If disturbed, they take refuge in mid-stream and, as has been repeatedly noted, usually resort to the sand-banks rather than to the water. The flood-bank (see Fig. 12), running from N.E. to S.W., offers exceptional cover for the observer, for no matter where the birds are feeding, they can, with due caution, be approached and viewed at fairly close range. It may indeed be said that there is probably no place in the British Isles where geese can be seen to better advantage.

In February, 1942, for the first time within memory, many of the geese made daily visits to the Castle meadow at Berkeley. There is, however, little evidence to show that they are in the habit of going far inland to feed. That small gaggles are sometimes to be seen leaving, or returning to the New Grounds suggests that they do occasionally visit inland meadows, or even go as far as the Cotswolds.¹ During the abnormally severe weather of January and February, 1940, geese, many of them probably driven out from the New Grounds, became widespread in south Gloucestershire, several being obtained near

¹ Evans (1878-81) records that "Large flocks of Geese fly over during winter to feed on the young corn on the top of the hills, and where notwithstanding all the vigilance of the old ganders, many are shot." Mellersh (1902) in referring to the Cotswolds mentions that White-fronted Geese are sometimes shot; also that some species of goose used annually to visit certain arable fields in September, but that the visits were discontinued after a time. These, he suggests, were possibly Pink-footed Geese on their way to the Severn.

Avonmouth, and others within the Bristol city boundary (Davis, 1940).

With regard to recent years it should here be mentioned that Blathwayt (1932) gives a short but excellent account of wild geese as they are to be found on these Severn pastures.

II. VARIATIONS

In writing of the New Grounds geese, Berkeley (1854) states that "There have been occasional instances of white geese appearing among them, to which the cow-herds or farmer's men have approached so near that they could be sure of the species; but from no crafty steps having been taken to kill them these rare specimens have hitherto escaped." There seems little reason to doubt that these white geese were albinistic varieties. Such varieties have been noted on the New Grounds on two occasions within the last few years. A creamy-white bird seen among some 1500 White-fronts on January 8, 1939, was still present on February 15, while a similarly coloured example was observed among 110 Pink-feet on October 10, 1943. In both cases the abnormal bird was quite evidently of the same species as its companions.

An interesting record is that of two presumed hybrids seen on December 31, 1939. These, showing marked characters of both Barnacle and "grey goose," were feeding among a large flock of White-fronts and in close company with two normal Barnacles. The body plumage, almost uniformly mouse-grey, showed decided "grey goose" tendencies, while the head pattern was essentially Barnacle, though duller and less sharply defined. Bill coloration was also Barnacle, but the legs, as seen through a 30 × telescope, were drab-yellow. It seems likely that the birds were Barnacle × "grey goose" hybrids and, as suggested by Dr. John Berry, the leg-coloration indicates a Barnacle-White-front cross. While natural hybridisation between these two species is by no means impossible, it may be pointed out that, whereas the Barnacle and Pink-foot breed within the same areas, the breeding ranges of the Barnacle and White-front only overlap to a very small extent. As hybrid geese are sometimes reared in captivity, there is the further possibility that these birds had escaped from confinement. Here it may be of interest to state that Yarrell (1845) mentions an instance of the successful hatching of Barnacle × White-front hybrids.

III. SYSTEMATIC LIST

Except where otherwise stated the records listed below apply only to the New Grounds. Those for the years 1932-43 are almost entirely the result of observations by the following observers—H. G. Alexander, W. B. Alexander, Rev. F. L. Blathwayt, H. H. Davis, H. C. Playne, H. Tetley and B. W. Tucker. In cases where the identity of the actual observer seems necessary, the appropriate initials are quoted. The numbers of geese given represent either accurate counts or, as with some of the larger totals, are the result of careful approximations.

ANSER ANSER ANSER (L.) Grey Lag-Goose

Although included by Berkeley (1854) among the geese stated to have been killed, he gives no clue as to how often it was obtained. The "great grey goose" referred to by the same author may have been this species but, as already pointed out, may equally have been the Pink-foot. Evans, in his county list (1878-81), includes the Grey Lag among those geese which are stated to be common on the Severn, while Walsingham and Payne-Gallwey (1897) mention it as being among those chiefly shot near Berkeley Castle. Mellersh (1902 and 1907), however, refers to it as being "exceedingly rare" and a "mere straggler"—descriptions which agree with what appears to be its present-day status. There is, indeed, little to show that the Grey Lag is now more than a very occasional visitor. A few may have been present on January 9, 1930, when a distant view was obtained of six large grey geese with yellowish bills. The only fully authentic records within recent years are those of single birds seen at close quarters on October 8 and 22, 1933, and on October 13, 1939. An adult female in the collection of Dr. O. H. Wild was obtained at Frampton-on-Severn on December 6, 1930.

ANSER ALBIFRONS ALBIFRONS (Scop.) White-fronted Goose

This is, and probably has been for many years, the common goose of the New Grounds. Berkeley (1854), Evans (1878-81) and Payne-Gallwey (1896) all refer to it, while Saunders (1899) mentions it as being found in large numbers on the Severn near Berkeley. Mellersh (1902 and 1907) gives further evidence of its great abundance early in the present century. Observations in recent years show that the White-front begins to arrive during the first half of October, and though often outnumbered for a few weeks by the Pink-foot, it increases rapidly and, from about mid-November until its departure in the

first half of March, is the predominant species. Within this period, numbers usually vary between 1000 and 2500, though on some occasions many more have been seen. On December 26, 1940, there were certainly not less than 3500, while on February 23, 1941, on two dates in February, 1942, and again on December 16, 1943, the totals were probably little short of 3000. To what extent numbers have varied in the past is not known, but these figures, higher than any recorded during the previous eight years, suggest that the bird is at present becoming more plentiful.

ANSER FABALIS FABALIS (Lath.) Bean-Goose

Owing to the confusion which for long existed between this and the Pink-foot, early records of its occurrence must be regarded with caution. Berkeley (1854) mentions both species and includes both among the geese stated to have been killed. Remarks by Payne-Gallwey (1896) and Mellersh (1902) suggest that the Bean used to be a regular visitor in considerable numbers from September to November. Mellersh implies that it often outnumbered the Pink-foot, but writing later (1907) appears to be in some doubt when he states "The question of the Bean-Goose . . . has not yet been settled. It certainly is not a mere straggler . . . for small flocks occur at various times during the goose season." The same author in correspondence with the Rev. F. L. Blathwayt (under date November 5, 1933) refers to his 1902 account as being wrong and quotes the local wildfowler L. Purcell as saying that the Bean-Geese come in December, not earlier in the autumn. This, however, is not borne out by observations since 1932 and it can only be said that, whatever the bird's status in the past, it is evidently no more than a scarce visitor at any time now. Capt. R. G. W. Berkeley informs us that within the last twenty years specimens have occasionally been shot but that none of these have been preserved. The occurrence of at least two during the severe weather of February, 1940, provides the only recent sight record. One seen on the 13th (H.H.D.) was clearly identified by its dark plumage, bright orange legs and generally long and slender appearance. Its black bill, with sharply defined orange-yellow band, was conspicuously large as compared with those of a few Pink-feet feeding nearby. A similar bird, with the bill coloration rather paler, was seen among White-fronts on the 21st (F.L.B. and H.H.D.). As recorded by Berry (1940), two unusually large Bean-Geese, of an undefined race, were shot from a small gaggle which visited the Severn between Arlingham and Berkeley about the year, 1912.

ANSER FABALIS BRACHYRHYNCHUS Baillon. Pink-footed Goose

There can be little doubt that this was the species referred to by Berkeley (1854) when he wrote of the "pink-toed goose" and, as previously suggested, the "great grey goose" of the same author may also have been the Pink-foot. From remarks by Gould it appears that the figures of this bird in his monumental work *The Birds of Great Britain* (1873) were drawn from specimens sent by Lord Fitzhardinge (and presumably obtained on the New Grounds). That it was regarded as an abundant visitor nearly fifty years ago is evident from statements by Payne-Gallwey (1896) and Mellersh (1902). The former was no doubt referring to the New Grounds when he wrote of having seen Pink-footed Geese in large numbers on the banks of the Severn. Although neither author gives any very definite information as to numbers, the remarks of both that it arrives in the latter half of September and leaves in late October or November agree well with the results of recent observations. During the years 1932-43 the average arrival date has been September 17, and although it has not always been possible to ascertain that the first birds were Pink-feet, there seems no reason to think otherwise. The departure, which coincides with the arrival of many of the White-fronts, is apparently variable and evidently takes place at anytime between late October and mid-December. From 1932 to 1937 numbers exceeding the 1000 mark were fairly frequently noted—the maximum total being about 1250 on both November 5, 1933, and November 21, 1934. During the years 1938 and 1939, however, the highest number seen was down to 650. This decrease became even more marked from 1940 onwards when the largest count amounted to no more than 110. Although observations in these last three years have of necessity been fewer, it seems evident that for the time being the species is becoming far less plentiful. A few are occasionally to be met with from January to March. Twenty-five on February 21, 1940, is the highest number noted.

ANSER HYPERBOREUS Pall. subsp. ? Snow-Goose

In summarising the records of this goose on the Severn, Mellersh (1912) gives the following instances—three prior to 1885, eight (adults and immatures) for about four days in October, 1901, and three adults, which stayed for several weeks, in November, 1906. It may be pointed out here that the first of these is not included among the records admitted by Witherby (1939). It appears evident that both the 1901 and 1906 birds occurred either on or in close proximity to the

New Grounds. As no specimens were obtained, it is not known to which form they belonged. Capt. R. G. W. Berkeley tells us that during the winter of 1916-17 three adults visited the New Grounds and remained there for some considerable time. One of these, said to be of the smaller form (*Anser h. hyperboreus*), was eventually shot by the decoyman Nicholls and is now preserved at Berkeley Castle. As Snow-Geese have appeared in the British Isles on quite a number of occasions in the last half-century, and in widely separated areas, there seems no reason why truly wild specimens should not sometimes visit the Severn. It must not, however, be overlooked that some of the New Grounds birds may have escaped from captivity.

BRANTA RUFICOLLIS (Pall.) Red-breasted Goose

As recorded by Davis and Tucker (1941), an immature Red-breasted Goose was seen feeding among a large flock of White-fronts on February 16, 1941. It was seen again on the 23rd and was probably still present on the 26th. An adult shot near Oldbury-on-Severn on November 18, 1909, and recorded by Robinson (1910), is now in the Bristol Museum collection. In both cases the bird appears to have been a genuinely wild visitor.

BRANTA LEUCOPSIS (Bechst.) Barnacle-Goose

Very little has been recorded of this species on the Severn. Neither Berkeley (1854) nor Payne-Gallwey (1896) makes any mention of it although Evans (1878-81) says that it is "not uncommon." Mellersh (1902) merely states that there are less than three or four records, and later (1907) refers to it only as a "mere straggler." Observations during the years 1932-43 show that the Barnacle occurs regularly in very small numbers and that at any time between September and March odd birds (sometimes three or four) may be seen feeding among the large flocks of grey geese. The skin of a male in the Bristol Museum collection is labelled R. Severn, Glos., January 11th, 1928.

BRANTA BERNICLA BERNICLA (L.) Dark-breasted Brent Goose

There is nothing to indicate that the Brent has ever been regarded as a frequent visitor to the Severn. Mellersh (1902), in writing of the New Grounds, mentions that it is "but a passing visitor in small numbers and rarely shot with the other geese." This fully agrees with what is evidently its status at the present time. Two instances of the bird having been shot within fairly recent years have been given by Capt. R. G. W. Berkeley who tells us that two were obtained in 1928 and one in 1933. The form to which these belonged is not known.

The only Brent observations for the years 1932-43 are those of single birds on February 4, 1933, and December 19, 1934; two on February 4, 1937; two or three in February, 1940, and three from February 23 to March 2, 1941. The 1933 bird was seen on the water and the others among grey geese on the saltings. With one exception (see below) all were of the dark-breasted form. Up to thirteen in number frequented the Severn bank near Avonmouth from early February to early March, 1937. These were also dark-breasted birds (Davis and Tetley, 1937).

BRANTA BERNICLA HROTA (Müll.) Pale-breasted Brent Goose

One of three Brents which stayed from February 23 to March 2, 1941 (or later) was noticeably much paler on both flanks and breast than its companions. On the latter date the bird was seen by W.B.A. who confidently identified it as being of this form. As there is no previous record, it appears that pale-breasted examples seldom visit the Severn.

BRANTA CANADENSIS CANADENSIS (L.) Canada Goose

Although known to become fairly widespread in the British Isles outside the breeding season, and sometimes to associate with grey geese, the Canada Goose is evidently an uncommon visitor to the New Grounds. The only records are those of a single bird seen among a large gathering of White-fronts on various dates from mid-December, 1939, to early March, 1940, and of one (perhaps the same) seen on two occasions in February, 1941.

IV. NOTES ON MIGRATION AND SYSTEMATICS

During the last twelve years the two principal wild geese have been the Pink-footed and the White-fronted, though changes may well occur in the future. Indeed, in the last few years, even though observations have necessarily been fewer, the former have become much scarcer and the latter more plentiful. The Pink-feet arrive and leave first, the others coming in later and staying much longer. Pink-feet come about the middle of September, and it seems likely that they come from the east, though this is by no means certain. But it is interesting to find that this is also the approximate time of their arrival in Scotland, and on the Solway and the coast of Lincolnshire, and, that being the case, it seems more likely that they come across the country from Lincolnshire rather than from their nearest resort on the west coast, i.e. the river Ribble. It may be possible to work out these movements

by the odd albinistic birds which turn up among the flocks from time to time, but this has not been done so far. In any case, the time of arrival seems striking. Pink-feet breed only in N.E. Greenland, Iceland and Spitsbergen, and possibly in Franz Josef Land, and do not begin breeding until early June. The eggs hatch by the end of the month and it is not until the end of August that the young are fully fledged. Yet about a fortnight or three weeks later they appear on the Severn, at least 1000 miles away. Dr. John Berry tells us that there are relatively large numbers of non-breeders in Iceland, and these may well migrate earlier than the breeding birds and so account for the earlier arrivals. Supposing these come to the Severn, all of them would be in adult plumage, whereas the others would include both old and young, the latter being recognised by their yellowish legs and lack of colour on their bills. Unfortunately, present notes are not adequate to deal with this point, and the earliest available date is October 8, 1933, when, among 1000 Pink-feet, there were a good number of young birds. It is hoped at some future date to examine the early flocks more thoroughly and so settle this point. These geese leave the Severn in December, or earlier, and must go either north-west to the Ribble or further north, or to the east coast, for the Severn is the most south-westerly of their winter haunts, either in this country or in Europe. But it does seem curious that they should leave so early unless, indeed, they are crowded out by the ever-increasing numbers of White-fronts.

The White-fronted Geese perform great migrations to and from the Severn. They breed only in N.E. Russia and further east to Siberia, or in N.W. Greenland or Arctic Canada, in any case about 2300 miles away at the least, so it is not to be wondered at that they appear later than the Pink-feet which *may* come from Iceland. Their departure, said to be in the Stroud direction and making east, is about the beginning of March, i.e. about two months before they begin breeding. It seems as if these geese move up north towards Scotland where large numbers flock in the spring before moving across the water to their breeding grounds. There is one systematic point which has only recently been appreciated, so unfortunately there are very few notes on it, i.e. the colour of the bill of the adults, but H.H.D. examined flocks of about 1000 on November 12 and about 3000 on December 16, both 1943, and found that the adults had pink bills, and this is believed to be the case with those seen previously. Birds breeding in West Greenland are thought to have yellow bills and darker plumage, and in Scotland it seems probable according to Berry (1939) that those

on the western isles conform to the supposed Greenland type, while those on the east are pink-billed and paler in plumage. It would be natural to suppose that the Greenland birds would come to the western side of this country, and the Siberian to the east, but the whole question has not been thoroughly examined, so no definite decision has been reached. It is obviously a point of importance in giving a clue to the origin of these birds.

During this period the Bean-Goose has been only a very rare straggler, but attention may be drawn to "Notes on two unusual Bean-Geese from the Severn Estuary" (Berry, 1940) in which the author describes two unusually large birds, one complete, the other only a head, obtained about 1912 by L. Purcell, the local wildfowler. Both of these have large and heavy bills, and represent a Siberian form not known before from this country. It may be added that the complete bird was later presented to the Bristol Museum and Art Gallery by Mr. J. C. M. Nichols. The writers believe it to be an example of the Eastern Bean-Goose (*Anser fabalis serrirostris*), but the systematics of this species are difficult and not yet settled.

The Brent Goose comes as odd birds or in very small parties, and almost all those seen, as well as a flock of thirteen lower down the estuary in February, 1937, have been dark-breasted birds, i.e. those that breed in Siberia.

From this same country would come the two Red-breasted Geese (Oldbury-on-Severn, 1909, and New Grounds, 1941), the only records for this area.

Finally, it may be recorded that there are skins of wild geese from the Severn in the American Museum of Natural History, New York. These were formerly in Lord Rothschild's collection at Tring but were, in 1932, transferred to America when the greater part of the bird-skins were sold to that Museum. Dr. E. Mayr was good enough to inform me (H.T.) of this in 1937 and sent a list of the skins of White-fronted and Pink-footed Geese. These amount to 25 of the former and 3 of the latter, and their registration numbers are 730635-730647 and 730691-730702 for the White-fronts, and 730796-730798 for the Pink-feet.

In conclusion the writers wish to record their thanks to Capt. R. G. W. Berkeley for much useful information and for kind permission to publish this account. Thanks are also due to the Rev. F. L. Blathwayt for his co-operation in supplying some of the historical details and for

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The Vegetation of Berrow, North Somerset

By GERTRUDE M. BOLEY

(Received, Feb. 12, 1944. Read in title, March 2, 1944)

2. THE SAND DUNE SUCCESSION

I. INTRODUCTION

IN continuation of Part I of "The Vegetation of Berrow" (Boley, 1942) this paper has as its object a description of the vegetation of the coastal sand-dune succession and a comparison with the observations of previous workers.

The sand-dune succession includes two plant communities:—

1. the foreshore community on the strand,
2. the sand-dune community.

Observations on the vegetation of this region have been made by Moss (1907), Watson (1918) and Thompson (1922, 1930). In addition to these published records, studies made over a series of years by students of Bristol University have been available, and the region has been visited periodically from April to October, 1943. Lists of species have been made, characteristic specimens collected and soil samples taken and analysed.

II. PREVIOUS WORK

Moss (1907) gives the following description of the region: "The Berrow flats at low spring tide are four miles in width. Owing to constant movement of the surface, caused by the ebb and flow of the tides, the flats possess no vegetation. The prevailing west and north westerly winds drive tiny particles of sand onwards and, in times of high wind, sand blizzards are frequent." This moving sand forms the nucleus in the formation of sand-dunes which have been laid down over tidal mud, apparently recent in origin. He records a fringe of plants which frequently occurs beyond a line of débris at the foot of a line of pre-dunes, formed by the action of the sea couchgrass. Behind the low dunes dominated by *Agropyron*, higher dune ranges occur

whose crests are characterised by tufts of marram grass, often buried under an accumulation of sand. Underground stems have the power of growing rapidly upwards. Between Highbridge and Weston the dunes are seen westward as a line of low hills which keep the high tide from the reclaimed levels.

Of the dune marshes Moss writes: "In spite of the great porosity of the sand, the dunes in the older hollows are badly drained. The tidal alluvium on which the dunes rest is wetter at high tide than low tide, and, as the sand is only a few feet deep in the hollows, capillarity tends to counteract porosity. Further, a layer of humus is often found on the surface of the older fixed dune-hollows, and in such places rain water collects and becomes stagnant." The largest marsh in the district, Berrow Marsh, was about three-quarters of a mile long and a quarter of a mile broad, situated between a range of low dunes to seaward and higher dunes on the landward side. In 1906 this area was being drained for a golf-course.

Watson (1918) writes: "The only part of the Somerset coast which has well-marked sand-dunes lies between Burnham and Brean Down. They extend along the coast for over 5 miles and at their widest point are about half-a-mile broad. They are much inferior to those at Braunton, not only in extent but also in the altitude of the sand-hills themselves. There are no well-marked lines of ridges and furrows, but numerous pools occur, most of which are of temporary duration."

Thompson (1922) recognises three natural belts of vegetation:—

Belt A. *Triticum junceum* association.

Belt B. *Carex arenaria* association.

Belt C. *Psamma arenaria* association.

He gives a comparative list of strand plants.

In his second paper (1930) he describes the progressive changes taking place on the foreshore, especially in the area southwest of Berrow Church, and expresses the opinion that the changes were due to rapid development of the salt-marsh.

Notable changes in the flora were the appearance in 1922 of *Beta maritima*, not seen by Moss in 1906, and the lessened frequency of *Glaucium flavum*, *Polygonum Ravi* and *Eryngium maritimum*. In 1929 small numbers of *Glaux maritima* and *Spergularia marginata* were found growing together with *Juncus Gerardi* on the foreshore near the edge of the salt-marsh.

III. THE VEGETATION IN 1943

The region dealt with corresponds to the area surveyed and described by Thompson (1922, 1930). It starts 450 yds. north of Berrow Low Lighthouse and extends northwards towards Brean for $1\frac{3}{4}$ miles, varying in width from 350 to 600 yds. The chief physical feature is a maze of irregular mobile and fixed dunes bordering, on the one side, a low flat coast-line and, on the other, a well-established golf-course. The sand-dune succession comprises three plant communities:—

1. The foreshore community.
2. Sea couchgrass consocieties (*Agropyretum juncei*).
3. Marram grass consocieties (*Ammophiletum arenariæ*).

The first of these passes into salt-marsh and the last into dune pasture and dune marsh. A belt of *Carex arenaria*, described by Thompson (1922) as occurring between 2 and 3, persists only in traces, though the plant is still abundant and locally sub-dominant in both communities. The present climax is reached in the development of scrub.

1. **FORESHORE COMMUNITY.** This may be regarded as the first phase of the sand-dune succession. Immediately northwest of Berrow Church the foreshore is bare of vegetation, but beyond the northern limits of the golf-course a fringe of strand plants frequently occurs. Sparsely scattered groups of succulents may also be found occasionally southwest of the Church, along the narrow trackway which separates the land from the salt-marsh. Evidences of progressive change in the foreshore vegetation are abundant along the southwestern limits of the area, where there is now a mixed community of maritime and non-maritime species; the seaward fringe is invaded by halophytes. Perhaps the most interesting expression of this is the colonisation by the sea aster, which has crossed over from the marsh and now dominates local patches of mud beyond the line of decaying debris.

2. **SEA COUCHGRASS CONSOCIETIES** (*Agropyretum juncei*). Progression in sand-dune formation may be seen all along the coast at Berrow from embryo dunes on the foreshore to the final transition from mobile to fixed dunes. *Agropyron junceum* is the pioneer colonist. Seeds fall on the accumulating sand, arrested by obstacles along the line of drift, and, given favourable conditions, germinate and grow. The developing plants produce long creeping rhizomes which anchor in and stabilise the mobile sand, while the vertical shoots penetrate the surface layers. Although limited in its activities as a sandbinder,

the sea couchgrass is tolerant, within limits, of salt water. It can stabilise sand-dunes close to the tidal limits and to a height of several feet. The line of fore-dunes bordering the strand northwest of Berrow Church reaches a height of 4 to 5 ft. This belt is subject to erosion. Part of the seaward margin is carried off by spring and autumn tides, but fresh accumulations of drifting sand are soon invaded and colonised by this vigorous plant. Associated species are most abundant on the landward side and here a few colonies of sea buckthorn occur.

3. MARRAM GRASS CONSOCIES (*Ammophiletum arenariæ*). Mobile dunes dominated by marram grass, often the only plant growing on them, are a distinctive feature of the region. Their structure is unstable and liable to erosion by the strong westerly winds and storms. On the face of eroded dunes the extensive rooting system of the grass may often be seen. A very slight displacement of the sand will reveal masses of deeply penetrating roots and rhizomes. At the lower levels of the blow-out the roots are dead or dying, but higher up the plant sends out vigorous laterals which push vertical shoots up through the sand and form the characteristic tufts of grass. This unique power of lateral and vertical extension makes *Ammophila* more successful than *Agropyron* as a sand-binder; but, unlike the latter, it is intolerant of salt water and cannot colonise within reach of the sea. It has, however, invaded fore-dunes protected by the salt-marsh.

Over the dune ranges, a successional series of plant communities is found. The community of the mobile dunes dominated by marram grass is generally open. As the surface becomes covered by other plants the grass shows loss of vigour, and, on many of the older fixed dunes, it occurs only in scattered patches as a dying relict. Consolidation of the sandy surface is brought about by the invasion of those species which can best establish themselves in the loose sand which surrounds the tufts of marram grass. A considerable variety of species is concerned. Mosses and lichens are abundant and play a considerable part in the fixation of the surface sand. This subject has been dealt with by Watson (1918). Of phanerogams, *Festuca* is an early associate. Its bright green tufts may frequently be seen on the sand-hills and it is a dominant species of dune sward and pasture. *Carex arenaria* is very abundant on the loose sandy slopes of mobile dunes and in the more sheltered valleys between the ranges. *Senecio Jacobæa*, *Euphorbia Paralias*, *Calystegia Soldanella* are often abundant and may be locally dominant. *Iris Pseudacorus* occurs throughout but seems to favour the southern slopes of the steeper mobile dunes.

4. DUNE SWARD AND DUNE PASTURE. The marram grass consociation merges into sward and pasture. Many acres of the dunes area have been drained and converted into golf-links, which now support a close turf of characteristic species. The valleys and hollows of the dunes protected from the violence of sand-storms are colonised by a rich and varied flora of intermediate type. Many species are able to establish themselves in the shelter of the dunes which could not survive on the more open surface. Both open and closed communities occur and some species attain local dominance. Plants were listed in a valley 30 yds. wide running north and south for 300 yds., between two ridges 80 yds. east of the salt-marsh. Here *Festuca rubra* and *Holcus lanatus* were co-dominants and *Arundo Phragmites* a sub-dominant *Ammophila arenaria*, *Senecio Jacobæa* and *Hippophaë rhamnoides* were abundant. *Trifolium arvense* and *Anthyllis vulneraria* were dominant in local patches ranging from 130 to 350 sq. yds. in area.

5. DUNE MARSH. In the area artificially drained for the golf-course a few pools and damp hollows remain. These occur chiefly in the hollows of the older dunes to the north of Berrow Church. Their vegetation is dominated by *Hydrocotyle vulgaris* and various mosses. The largest marsh lies in a shallow valley near the sea northwest of the Church. It is 30 yds. wide and 200 yds. long and lies between the fore-dunes and the forward line of higher dunes. The vegetation is zoned and is a mixture of maritime and non-maritime species.

6. SCRUB. The present climax of the succession is scrub dominated by *Hippophaë rhamnoides*. Not a native here, this shrub is rapidly colonising the sand-hills and seems to be spreading naturally in a northwesterly direction.

In 1922 Thompson records the buckthorn as occurring above and behind the zone of marram grass and forming a low scrub or sometimes reaching a height of 15 ft. An old inhabitant of the district has stated that it was first brought from Ireland and planted at Berrow 40 years ago. Since then cuttings have been planted on the mobile dunes to fix the sand and help to protect the levels. Its spread has been remarkable and it is now established in large colonies along the fore-shore and may be found invading the salt-marsh. The vigorous spread is due to the production of long horizontal suckers which throw up vertical shoots freely and provide a means of rapid increase. The tenacity of the plant is such that, in blow-outs, fresh shoots may be seen growing from apparently dead suckers.

IV. ECOLOGICAL FACTORS

The region described begins with the mud of the salt-marsh covered at high tides and backed by the higher strand, where sand overlies or is mixed with the recent alluvial mud. Behind this rise the dunes to a height ranging from 3 to 30 ft. The soil ranges from sandy mud to pure sand and shows corresponding differences in organic matter and water content. A series of soil analyses is given in Table I. With a pH value of 8 the soils are strongly basic; only in one sample did the value fall as low as 7.5.

TABLE I
SOIL ANALYSES

Station	Plant Cover	Depth of Sample, inches	Water Content, %	Organic Matter Content, %	Re-action (pH)
STRAND					
Muddy sand ..	<i>Aster Tripolium</i> ..	4.0	19.6	0.98	8.0
Muddy sand ..	<i>Atriplex patula</i> ..	5.0	15.7	1.12	8.0
Low Sandhill ..	<i>Arenaria peploides</i> ..	4.5	3.37	2.3	8.0
SAND-DUNES					
1st line, exposed	<i>Convolvulus Soldanella</i>	5.0	1.36	0.6	7.5
1st line, sheltered	<i>Oenothera biennis</i> ..	5.5	4.66	0.47	8.0
2nd line, sheltered	<i>Carex arenaria</i> and <i>Cynoglossum officinale</i>	5.0	2.15	1.04	8.0

The vegetation is locally modified by the grazing of sheep and the burrowing of rabbits; and also by artificial drainage and quarrying for sand.

V. CONCLUSION

Since 1922 the marsh has spread eastward to within a few yards of high tide mark. The influence of a gradually changing habitat may be seen in the variety of non-maritime species colonising the strand at the southern end of the marsh. Further north the entrance of other species has deprived the belt of *Carex arenaria* of its individuality. Throughout the area the sea buckthorn, originally planted, now not only dominates the dune crests but spreads into the valleys. A complete list of all plants recorded from the area in 1906 (Moss), 1922 and 1929 (Thompson), and 1943 is given in Table II.

TABLE II

PLANTS RECORDED FROM THE SAND DUNE SUCCESSION AT BERROW

A. STRAND

	1906	1922	1929	1943
<i>Arenaria peploides</i> L.	R.	O.	O.	L.F.
<i>Aster Tripolium</i> L.	—	O.	O.	L.A.
<i>Atriplex Babingtonii</i> Woods	A.	—	—	—
<i>hastata</i> L.	A.	—	—	L.A.
sp.	—	O.	O.	—
<i>Beta maritima</i> L.	—	O.	—	L.F.
<i>Cakile maritima</i> Scop.	R.	R.	R.	L.F.
<i>Cardamine hirsuta</i> L.	—	—	—	O.
<i>pratensis</i> L.	—	—	—	O.
<i>Carduus arvensis</i> Robs.	—	—	—	L.F.
<i>lanceolatus</i> L.	—	—	—	O.
<i>Cerastium arvense</i> L.	—	—	—	O.
<i>Chenopodium album</i> L.	R.	—	—	L.F.
<i>rubrum</i> L.	R.	—	—	O.
<i>Cynoglossum officinale</i> L.	—	—	O.	O.
<i>Dipsacus sylvestris</i> Huds.	—	—	—	O.
<i>Euphorbia Paralias</i> L.	—	—	—	L.F.
<i>Glaucium flavum</i> Crantz	R.	V.R.	—	—
<i>Glaux maritima</i> L.	—	—	R.	L.F.
<i>Glyceria maritima</i> Wahlb.	—	—	O.	L.F.
<i>Hippophaë rhamnoides</i> L.	—	—	—	L.A.
<i>Myosotis caespitosa</i> Schultz	—	—	O.	—
<i>Nasturtium palustre</i> DC	—	—	O.	—
<i>Phragmites communis</i> Trin.	—	—	—	L.A.
<i>Plantago Coronopus</i> L.	—	—	O.	O.
<i>Polygonum Raii</i> Bab.	R.	V.R.	V.R.	V.R.
<i>Ranunculus sceleratus</i> L.	—	—	O.	—
<i>Salsola Kali</i> L.	A.	A.	A.	L.A.
<i>Senecio Jacobæa</i> L.	—	—	—	L.A.
<i>vulgaris</i> L.	—	—	—	L.F.
<i>Spergularia marginata</i> DC	—	—	O.	R.
<i>salina</i> Presl.	—	—	R.	—
<i>Suaeda maritima</i> Dum.	—	V.R.	O.	V.R.

B. AGROPYRETUM

	1906	1922	1929	1943
<i>Agropyron junceum</i> Beauv.	D.	D.	D.	D.
<i>Arenaria peploides</i> L.	F.	—	—	L.A.
<i>Atriplex Babingtonii</i> Woods	O.	—	—	—
<i>hastata</i> L.	O.	—	—	O.
sp.	—	O.	—	—
<i>Cakile maritima</i> Scop.	O.	—	—	L.F.
<i>Carex arenaria</i> L.	S.D.	S.D.	S.D.	L.D.
<i>Caucalis arvensis</i> Huds.	O.	—	—	—
<i>Eryngium maritimum</i> L.	O.	—	—	O.
<i>Euphorbia Paralias</i> L.	O.	—	—	L.A.
<i>Glaucium flavum</i> Crantz	O.	R.	—	—
<i>Hippophaë rhamnoides</i> L.	—	—	—	O.
<i>Rumex crispus</i> L.	O.	O.	—	—

C. AMMOPHILETUM

	1906	1922	1929	1943
<i>Agropyron junceum</i> Beauv. ..	F.	O.	—	O.
<i>Ammophila arenaria</i> Link. ..	D.	D.	D.	D.
<i>Arenaria peploides</i> L. ..	F.	—	—	L.A.
<i>Calystegia Soldanella</i> Br. ..	F.	O.	—	L.A.
<i>Carex arenaria</i> L. ..	F.	A.	—	L.A.
<i>Crepis virens</i> L. ..	F.	F.	—	F.
<i>Cynoglossum officinale</i> L. ..	F.	F.	—	F.
<i>Elymus arenarius</i> L. ..	—	—	—	O.
<i>Erodium cicutarium</i> L'Her. ..	—	F.	—	F.
<i>Eryngium maritimum</i> L. ..	O.	O.	—	O.
<i>Euphorbia Paralias</i> L. ..	F.	A.	A.	L.S.D.
<i>Festuca rubra</i> var. <i>arenaria</i> Koch	A.	A.	—	A.
<i>uniglumis</i> Soland ..	A.	A.	—	A.
<i>Hippophaë rhamnoides</i> L. ..	F.	—	—	A.
<i>Iris foetidissima</i> L. ..	F.	—	—	L.A.
<i>Leontodon hirtus</i> L. ..	F.	F.	—	L.A.
<i>Oenothera biennis</i> L. ..	—	—	O.	F.
<i>odorata</i> Jacq. ..	—	—	O.	F.
<i>Ononis repens</i> L. ..	—	—	—	F.
<i>spinosa</i> L. ..	—	—	—	F.
<i>Phleum arenarium</i> L. ..	F.	F.	—	F.
<i>Salix</i> sp. ..	F.	—	—	L.F.
<i>Senecio Jacobæa</i> L. ..	O.	F.	—	L.S.D.
<i>Taxacum erythrospermum</i> DC ..	F.	F.	—	F.
<i>Viola canina</i> L. ..	—	—	—	F.

D. SWARD AND DUNE PASTURE

	1906	1922	1943
<i>Achillea millefolium</i> L. ..	—	—	A.
<i>Agrimonia Eupatoria</i> L. ..	—	—	F.
<i>Ajuga reptans</i> L. ..	—	—	F.
<i>Anagallis arvensis</i> L. ..	O.	—	L.F.
<i>Anthyllis vulneraria</i> L. ..	O.	—	L.A.
<i>Arenaria serpyllifolia</i> L. ..	A.	A.	A.
<i>Bellis perennis</i> L. ..	—	—	F.
<i>Bromus mollis</i> L. ..	A.	—	L.A.
<i>Calystegia Soldanella</i> Br. ..	A.	O.	F.
<i>Carduus arvensis</i> Robs. ..	—	—	L.F.
<i>nutans</i> L. ..	O.	—	O.
<i>pycnocephalus</i> L. ..	—	—	—
var. <i>tenuiflorus</i> Curt. ..	O.	—	—
<i>Carex arenaria</i> L. ..	C.D.	S.D.	A.
<i>Carlina vulgaris</i> L. ..	A.	—	F.
<i>Caucalis anthriscus</i> Huds. ..	—	—	F.
<i>Cerastium semidecandrum</i> L. ..	A.	A.	A.
<i>Convolvulus arvensis</i> L. ..	O.	—	O.
<i>Crepis virens</i> L. ..	A.	A.	A.
<i>Cynoglossum officinale</i> L. ..	A.	A.	F.
<i>Dactylis glomerata</i> L. ..	—	—	L.F.
<i>Dipsacus sylvestris</i> L. ..	—	—	L.F.
<i>Elymus arenarius</i> L. ..	O.	—	O.
<i>Equisetum arvense</i> L. ..	O.	—	L.A.

D. SWARD AND DUNE PASTURE—continued.

	1906	1922	1943
<i>Erodium cicutarium</i> L'Her.	A.	A.	A.
<i>maritimum</i> L.	O.	O.	—
<i>moschatum</i> L'Her.	A.	A.	A.
<i>Erophila verna</i> Mey.	A.	A.	A.
<i>Erythræa Centaurium</i> Pers.	A.	—	F.
<i>Festuca rubra</i> var. <i>arenaria</i> Koch	C.D.	S.D.	L.D.
<i>uniglumis</i> Soland	A.	A.	A.
<i>Galium Aparine</i> L.	—	—	L.F.
<i>verum</i> L.	S.D.	S.D.	L.A.
<i>Holcus lanatus</i> L.	—	—	L.A.
<i>Hordeum murinum</i> L.	O.	—	L.F.
<i>Inula Conyza</i> DC	O.	—	O.
<i>Iris foetidissima</i> L.	S.D.	F.	A.
<i>Leontodon hispidus</i> L.	—	—	F.
<i>Lepidium latifolium</i> L.	O.	—	—
<i>Lotus corniculatus</i> L.	S.D.	S.D.	L.A.
<i>Lycopsis arvensis</i> L.	A.	F.	O.
<i>Marrubium vulgare</i> L.	O.	—	—
<i>Matricaria inodora</i> L.	A.	—	L.A.
<i>Medicago lupulina</i> L.	—	—	A.
<i>sativa</i> L.	A.	—	L.F.
<i>Melilotus officinalis</i> Lam.	O.	—	L.F.
<i>Myosotis collina</i> Hoff.	A.	A.	—
<i>Oenothera biennis</i> L.	O.	O.	F.
<i>odorata</i> Jacq.	O.	O.	F.
<i>Ononis repens</i> L.	S.D.	S.D.	A.
<i>Ophrys apifera</i> Huds.	—	—	F.
<i>Phleum arenarium</i> L.	A.	A.	L.A.
<i>Plantago lanceolata</i> L.	A.	—	L.F.
<i>Poa pratensis</i> L.	A.	—	A.
<i>Potentilla anserina</i> L.	—	—	A.
<i>reptans</i> L.	A.	A.	F.
<i>erecta</i> Hamp.	—	—	F.
<i>Rosa canina</i> L.	—	—	O.
<i>pimpinellifolia</i> L.	O.	—	—
<i>Rubus fruticosus</i> L.	O.	—	F.
<i>Salix repens</i> L.	O.	—	L.A.
<i>Salvia Verbenaca</i> L.	O.	—	—
<i>Saponaria officinalis</i> L.	O.	—	L.A.
<i>Sedum acre</i> L.	S.D.	S.D.	L.A.
<i>Senecio Jacobæa</i> L.	S.D.	A.	A.
<i>Silene maritima</i> With.	O.	—	R.
<i>Sisymbrium Thalianum</i> Gay	A.	—	—
<i>Sonchus arvensis</i> L.	O.	—	O.
<i>Spiranthes spiralis</i> Kock	—	—	O.
<i>Thymus Serpyllum</i> L.	S.D.	—	F.
<i>Trifolium arvense</i> L.	A.	F.	L.A.
<i>pratense</i> L.	A.	—	A.
<i>procumbens</i> L.	O.	—	L.A.
<i>repens</i> L.	—	—	F.
<i>scabrum</i> L.	O.	—	—
<i>striatum</i> L.	O.	—	—
<i>Trigonella purpurascens</i> Lam.	O.	—	O.
<i>Valerianella olitoria</i> Pol.	—	—	L.F.
<i>Verbascum Thapsus</i> L.	O.	—	—
<i>Vicia lathyroides</i> L.	O.	—	F.
<i>Viola canina</i> L.	A.	A.	F.

E. DUNE MARSH

	1906	1943
<i>Agrostis palustris</i> Huds.	S.D.	A.
<i>Apium graveolens</i> L.	O.	O.
<i>Caltha palustris</i> L.	O.	—
<i>Carex extensa</i> Huds.	O.	O.
<i>flacca</i> Schreb.	A.	F.
<i>riparia</i> Curt.	A.	F.
<i>vulpina</i> L.	A.	A.
<i>Dipsacus sylvestris</i> Huds.	A.	O.
<i>Eleocharis palustris</i> R. and S.	A.	O.
<i>Epilobium hirsutum</i> L.	O.	O.
<i>palustre</i> L.	A.	F.
<i>Epipactis palustris</i> Crantz	S.D.	F.
<i>Equisetum palustre</i> L.	L.	L.A.
<i>variegatum</i> Schl.	O.	—
<i>Erythræa pulchella</i> Fr.	A.	O.
<i>Galium palustre</i> L.	A.	A.
<i>Glaux maritima</i> L.	A.	A.
<i>Glyceria maritima</i> Wahlb.	S.D.	A.
<i>Holcus lanatus</i> L.	A.	L.A.
<i>Hydrocotyle vulgaris</i> L.	C.D.	L.D.
<i>Iris Pseudacorus</i> L.	A.	O.
<i>Juncus bufonius</i> L.	S.D.	F.
<i>glaucus</i> Ehrh.	S.D.	F.
<i>Gerardi</i> Loisel	S.D.	F.
<i>lamprocarpus</i> Ehrh.	S.D.	—
<i>maritimus</i> Lam.	O.	—
<i>Lycopus europæus</i> L.	A.	F.
<i>Oenanthe Lachenalii</i> Gmel.	A.	F.
<i>Peucedanum sativum</i> B. and H.	A.	—
<i>Phragmites communis</i> Trin.	A.	L.A.
<i>Plantago Coronopus</i> L.	O.	O.
<i>maritima</i> L.	O.	O.
<i>Potentilla anserina</i> L.	C.D.	A.
<i>Ranunculus sceleratus</i> L.	O.	O.
<i>Rhinanthus major</i> Ehrh.	A.	O.
<i>Rumex crispus</i> L.	A.	F.
<i>conglomeratus</i> Murr.	A.	—
<i>Hydrolapathum</i> Huds.	A.	—
<i>Sagina nodosa</i> Fenz.	O.	O.
<i>Samolus Valerandi</i> L.	A.	—
<i>Scirpus maritimus</i> Lam.	A.	A.
<i>Scutellaria galericulata</i> L.	A.	F.
<i>Spiræa Ulmaria</i> L.	A.	F.
<i>Statice binervosa</i> C.E. Salm.	O.	L.F.
<i>Trifolium fragiferum</i> L.	O.	O.
<i>Valeriana officinalis</i> L.	O.	—

R.—rare: V.R.—very rare: O.—occasional: F.—frequent: L.F.—locally frequent: A.—abundant: L.A.—locally abundant: D.—dominant: C.D.—co-dominant: S.D.—sub-dominant: L.D.—locally dominant: L.S.D.—locally sub-dominant.

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The Geology of a Further Borehole at Filton, Glos.

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THE supply of water from No. 1 Borehole situated near Fairlawn House on the property of the Bristol Aeroplane Company was insufficient to meet requirements* and No. 2 Borehole was sunk at the extreme south-west corner of the Company's sports-field adjacent to the Southmead Road (see Fig. 13). A depth of 420 feet was reached when a pumping-test proved that no more than a few hundred gallons of water were available per hour. The Carboniferous Limestone, which had been penetrated for a distance of 279½ feet, was remarkably free of joints and the borehole had reached into the upper beds of the S₂ subzone which normally are not good water-bearing strata in the Bristol District. The unpromising geological conditions held little hope of a good water supply unless the borehole was carried to a much greater depth and it was therefore abandoned.

With the exception of the interval between 41 feet and 45 feet 5 inches, for which a core was obtained, the first 63 feet were driven by percussion boring; thereafter an almost continuous core was forthcoming down to 420 feet. The Carboniferous Limestone succession is similar to that already described for No. 1 Borehole, and therefore in the following record of No. 2 Borehole the lithological descriptions are given in less detail.

								Thick- ness ft. ins.	Total depth ft. ins.
Made ground	..	..	..	..	..	..	..	1 0	1 0
LIAS									
Yellow clay	..	..	..	..	..	..	..	7 0	8 0
Grey clay with calcareous nodules	..	..	..	..	..	..	..	33 0	41 0

* Whittard, W. F. and S. Smith. Geology of a Recent Borehole at Filton, Glos., *Proc. Bristol Nat. Soc.*, 4th Ser., vol. ix, part iv, 1943, pp. 434-450.

	Thick- ness ft. ins.	Total depth ft. ins.
Argillaceous limestone alternating with dark grey shale rich in <i>Ostrea liassica</i> , Strickland; the limestone provided <i>Pleuromya latei</i> , Richardson and Tutchter (<i>liassica</i> and <i>latei</i> beds)	1 2	42 2
Light grey, close-grained limestone	4	42 6
Calcareous shale with <i>Ostrea liassica</i> , <i>Protocardium phillipianum</i> (Dunker), <i>Pleuromya langportensis</i> , Richardson and Tutchter, and small gastropods (<i>langportensis</i> beds) ..	1	42 7
Grey limestone with <i>Ostrea</i> sp., <i>Modiola laevis</i> (Sowerby), <i>Protocardium phillipianum</i> , and <i>Pleuromya langportensis</i> (<i>langportensis</i> beds)	6	43 1
Grey, crystalline limestone with darker, shaly bands carrying iron pyrites; the fauna includes <i>Ostrea</i> sp., <i>Pecten</i> sp., <i>Modiola langportensis</i> , Richardson and Tutchter, and <i>Protocardium phillipianum</i> (<i>langportensis</i> beds)	9	43 10
Medium grey, crystalline limestone with dark, shaly bands carrying iron pyrites and <i>Ostrea</i> sp.	6	44 4
Pale grey, very fine-grained limestone present as nodules carried in a coarse-grained, calcareous matrix; the fossils collected include <i>Pseudomonotis decussata</i> (Münster), <i>Modiola langportensis</i> and <i>Pleuromya langportensis</i> (<i>langportensis</i> beds)	8	45 0

RHÆTIC

Cotham Marble showing a mammillated top surface	5	45 5
The interval was uncured but a black sludge was obtained, and at about 53 feet blocks of a <i>Pecten</i> Bed were recovered. At 63 feet a thin development of the Rhætic Bone Bed was found adherent to the top of the Tea Green Marls. The bone-bed is composed of a dark grey, clayey, coarse-grained sandstone which is sometimes cemented by calcite; it contains angular rock-fragments up to $\frac{1}{2}$ inch in length, coprolites, nodules of phosphate, the teeth of <i>Acrodus minimus</i> , Agassiz, <i>Hybodus cloacinus</i> , Quenstedt, and <i>Saurichthys</i> sp., and scales of <i>Gyrolepis alberti</i> , Agassiz ..	17 7	63 0

TRIAS

Tea Green Marls with dolomite crystals	12 0	75 0
Red and green mottled marls merging downwards to red marls	6	75 6
Red marls with much dolomite in the form of rhombohedral crystals	7 6	83 0
Hard band of grey marl	6	83 6
Red marl with some greenish-grey marl and many dolomite crystals	20 6	104 0
Green and red marl with several nodules of crystalline gypsum	5 3	109 3
Richly dolomitic, red marls with some greenish-grey bands	15 3	124 6
Yellowish-grey, dolomitic, arenaceous marl	3 6	128 0
Banded, buff and grey, compact, dolomitic, strongly arenaceous marls with drusies lined with dog-tooth calcite ..	5 6	133 6

	Thick- ness ft. ins.	Total depth ft. ins.
Medium grey, dolomitic marls with bands of dolomitised limestone and pellets of shale	2 9	136 3
Dolomitic Conglomerate in which large boulders of Carboniferous Limestone are embedded in a sandy, dolomitic breccia containing angular limestone fragments up to five inches in length. One large boulder was cut through for a distance of four feet. Below the boulder there were two inches of calcareous breccia, and beneath this a greenish, sandy shale with small pebbles of limestone, many of which were rotten	4 3	140 6

CARBONIFEROUS LIMESTONE. D₁ subzone.

Light grey, crystalline limestones, in places crinoidal, with many bands of grain limestones up to 4 feet thick; fossils include <i>Chonetes papilionaceus</i> (Phillips), <i>Productus hemisphericus</i> , Sowerby, and <i>Straparollus</i> near <i>S. dionysi</i> (Goldfuss)	18 0	158 6
Light and medium grey, crinoidal, subcrystalline limestones which yielded <i>Palæosmilium murchisoni</i> , E. and H., and a clisio-phyllid recalling, but not identical with, <i>Carruthersella compacta</i> , Garwood	6 0	164 6
Light and dark grey, clotted limestone	4	164 10
Light grey, crinoidal, subcrystalline limestone with athyrids	8	165 6
Mottled grey and pink, foraminiferal, crinoidal, subcrystalline limestone with <i>Syringopora</i> sp., <i>Lithostrotion martini</i> , E. and H., <i>Dibunophyllum bourtonense</i> , Garwood and Goodyear, <i>Koninckophyllum magnificum</i> , Thom. and Nich., and <i>Productus hemisphericus</i>	9 0	174 6
Grey and pinkish-grey, clotted, subcrystalline limestone which provided <i>Lithostrotion martini</i> and <i>Caninia juddi</i> (Thomson) emend. Lewis	7 6	182 0
Grey, foraminiferal limestone with <i>Lithostrotion martini</i>	2 0	184 0
Uncored	3 0	187 0
Grey, subcrystalline, crinoidal limestone with <i>Caninia juddi</i> , <i>Dibunophyllum</i> sp., and <i>Productus hemisphericus</i>	10 6	197 6
Dark grey and maroon, crinoidal, coral limestone with wisps of red shale; the fauna includes abundant <i>Lithostrotion martini</i> , <i>Caninia juddi</i> , <i>Palæosmilium murchisoni</i> and <i>Productus hemisphericus</i> while <i>Lithostrotion</i> nr. <i>L. junceum</i> (Fleming), <i>Dibunophyllum bourtonense</i> , <i>D. bristolense</i> , Garwood and Goodyear, and intermediate forms, and <i>Spirifer ovalis</i> , Phillips, also occur	2 0	199 6
Grey and maroon, rubbly limestone, with wisps of red shale, which becomes a more compact limestone in lower two feet; the rubbly beds yielded <i>Palæosmilium murchisoni</i> and <i>Productus (Gigantella) giganteus</i> (Martin) in abundance and also <i>Lithostrotion martini</i> and <i>Dibunophyllum bourtonense</i>	3 6	203 0
Grey, compact, subcrystalline limestone	1 0	204 0
Dark grey, rubbly, coral limestone which provided <i>Lithostrotion martini</i> , <i>Caninia juddi</i> , <i>Palæosmilium murchisoni</i> , <i>Dibunophyllum</i> sp., <i>Productus productus</i> (Martin), <i>P. hemisphericus</i> and <i>Phricodothyris lineata</i> (Martin)	2 0	206 0

	Thick- ness ft. ins.	Total depth ft. ins.
Medium grey, subcrystalline, non-oolitic, compact limestone with <i>Chonetes papilionaceus</i> , <i>Orthis</i> (<i>Schellwienella</i>) <i>crenistris</i> (Phillips) and <i>Productus</i> (<i>Gigantella</i>) <i>giganteus</i> ..	1 8	207 8
Dark grey, calcareous shale with <i>Phricodothyris lineata</i> and indeterminate brachiopod fragments	4	208 0
Medium grey, subcrystalline, compact limestone with <i>Lithostrotion martini</i> (large and small forms), <i>Palæosmilium murchisoni</i> , <i>Dibunophyllum</i> sp., <i>Koninckophyllum magnificum</i> , <i>Syringopora</i> sp., <i>Orthis</i> (<i>Schellwienella</i>) <i>crenistris</i> , <i>Productus</i> (<i>Gigantella</i>) <i>giganteus</i> and <i>Phricodothyris lineata</i> ..	9 9	217 9
Dark grey, crinoidal, crystalline limestone with wisps of dark grey shale at base containing <i>Lithostrotion martini</i> and <i>Palæosmilium murchisoni</i> ; other fossils include <i>Dibunophyllum bourtonense</i> , <i>Leptaena analoga</i> , Phillips, <i>Productus</i> (<i>Gigantella</i>) <i>giganteus</i> and <i>P. hemisphericus</i>	2 6	220 3
Red and grey, impure limestone with wisps and bands of red, calcareous shale	1 9	222 0
French-grey and pink, porcellaneous limestone with conchoidal fracture	3 0	225 0
Grey and pink, clotted limestone with bands of rubbly limestone, and towards the top a band rich in <i>Lithostrotion pauciradiale</i> (McCoy) and <i>Palæosmilium murchisoni</i> ; other fossils include <i>Dibunophyllum bourtonense</i> , fragmentary <i>Syringopora</i> , and <i>Productus hemisphericus</i>	5 0	230 0
French-grey and pink, porcellaneous limestone with conchoidal fracture	6	230 6
Grey, compact, crinoidal limestone with <i>Caninia juddi</i> , <i>Carcinophyllum vancouveri</i> , Salée, <i>Chonetes papilionaceus</i> , <i>Productus hemisphericus</i> , <i>P. (Overtonia) fimbriatus</i> , Sowerby, and athyrids	22 6	253 0
Ferruginous limestone with quartzite nodules	6	253 6
Pinkish-grey quartzite with <i>Syringopora reticulata</i> , Goldfuss	5 6	259 0
Grey, calcareous, fine-grained sandstone	1 5	260 5
Dark grey, pyritic, arenaceous shale	6	260 11
Medium grey, arenaceous, oolitic limestone with fossil fragments, passing down into a pinkish-brown quartzite some three feet in thickness	5 1	266 0
Pinkish-grey, fine-grained limestone passing down into an argillaceous bed carrying limestone nodules; the fauna comprises <i>Chaetetes septosus</i> (Fleming), <i>Syringopora</i> sp., <i>Lithostrotion martini</i> (small form) and <i>Productus</i> sp. ..	1 0	267 0
Grey, fine-grained sandstone carrying nodules of darker grey, oolitic and also fine-grained limestones; the beds yielded <i>Productus</i> sp.	4	267 4

CARBONIFEROUS LIMESTONE. S₂ subzone

Grey, compact limestone passing into a grey, clotted limestone; <i>Productus hemisphericus</i> and <i>Composita ficoidea</i> (Vaughan) were obtained	3 8	271 0
Dark grey, calcareous shale passing in the lower six inches into a brownish-grey, porcellaneous limestone interbedded with thin, shaly partings, the whole showing a wavy		

	Thick- ness ft. ins.	Total depth ft. ins.
bedding. Fragments of <i>Syringopora</i> sp. and corallites of <i>Lithostrotion martini</i> which had been crushed and recrystallised were obtained	1 0	272 0
Medium grey, compact limestone with brownish-grey, banded, porcellanous limestone. Thick, brown oil occurs in patches along calcite-filled joints. Two fossiliferous bands provided <i>Lithostrotion martini</i> , <i>Productus hemisphericus</i> and <i>Composita ficoidea</i>	2 0	274 0
Dark grey, compact limestone with a band two inches thick at the top consisting of black, shaly limestone crowded with <i>Composita ficoidea</i>	3 9	277 9
Dark grey limestone, interbedded with black, calcareous shale, crowded with <i>Composita ficoidea</i>	1 1	278 10
Dark grey limestone with small masses of porcellanous limestone	2 7	281 5
Nodular, porcellanous limestone with curved wisps of black shale	1 3	282 8
Dark grey limestone with indeterminate brachipod fragments	2 1	284 9
Black shale	2	284 11
Dark grey limestone with porcellanous masses	2 1	287 0
Concretionary bed with nodules surrounded by black shale..	9	287 9
Dark, fine-grained limestone with occasional porcellanous masses and thin bands of black, calcareous shale; <i>Lithostrotion martini</i> (large form) was collected	3 9	291 6
Dark, fine-grained limestone with bands of nodular limestone and a bed showing wavy banding. The fauna includes common <i>Composita ficoidea</i> and <i>Lithostrotion martini</i> , <i>Carcinophyllum vaughani</i> and <i>Productus hemisphericus</i> ..	9 6	301 0
Light grey, banded, fine-grained limestone	2 6	303 6
Dark grey, fine-grained limestone with a basal band, two inches thick, showing nodular, porcellanous material ..	6 8	310 2
Dark grey, subcrystalline, sometimes oolitic, limestone with occasional <i>Composita ficoidea</i>	4 7	314 9
Dark grey, shelly, crinoidal limestone	6	315 3
Dark grey, porcellanous limestone with wisps of black shale	1 6	316 9
Light, pinkish-grey, crinoidal limestone with bands of porcellanous nodular limestone, nodular algal limestone, and <i>Composita ficoidea</i>	6 0	322 9
Pinkish-grey limestone, occasionally oolitic, with porcellanous masses	2 0	324 9
Pinkish-grey, fine-grained and porcellanous limestone with shaly bands	2 1	326 10
Pinkish-grey limestone with numerous porcellanous masses and some algal nodules	1 1	327 11
Dark grey, fine-grained, subcrystalline limestone with showings of dark oil and bands rich in <i>Composita ficoidea</i> and <i>Carcinophyllum vaughani</i>	8 1	336 0
Dark grey, fine-grained limestone	4	336 4
Dark grey, red-stained, calcareous shale with crushed brachiopods	8	337 0

	Thick- ness ft. ins.	Total depth ft. ins.
Pinkish-grey, fine-grained limestone	1 0	338 0
Banded, highly calcareous, pink shale with crushed brachio- pods	2	338 2
Light grey, fine-grained, crystalline limestone with a band of pisolitic limestone six inches thick	3 10	342 0
Light grey, fine-grained limestone with occasional porcellan- ous masses	2 10	344 10
Light grey, oolitic and pisolitic limestone	1 2	346 0
Banded, pink and grey, fine-grained limestone	3 0	349 0
Nodular limestone with curved wisps of black shale	6	349 6
Fine-grained, compact, dark grey limestone with flinty frac- ture and <i>Composita ficoidea</i>	10	350 4
Nearly black, calcareous shale	3	350 7
Fine-grained, brownish-grey limestone with flinty fracture	1 5	352 0
Medium and light grey, coarsely crystalline limestone with <i>Chaetetes septosus</i> , <i>Productus hemisphericus</i> and <i>Composita ficoidea</i>	3 6	355 6
Dark grey, fine-grained limestone with a colony of <i>Chaetetes septosus</i> six inches across	1 10	357 4
Dark, brownish-grey, porcellanous limestone passing down into black shale	4 5	361 9
Medium grey, coarse-grained limestone with numerous <i>Com- posita ficoidea</i>	2 7	364 4
Grey limestone with small masses of porcellanous limestone	11	365 3
Light grey, oolitic limestone with <i>Composita ficoidea</i> ..	8 1	373 4
Medium grey, subcrystalline limestone	3 5	376 9
Dark and medium grey limestone with darker patches of porcellanous limestone	9	377 6
Light grey, oolitic limestone	2 0	379 6
Light grey, subcrystalline limestone with many <i>Composita ficoidea</i>	3 0	382 6
Light grey, subcrystalline limestone with bands of oolitic limestone up to two feet in thickness; <i>Carcinophyllum vaughani</i> , <i>Productus hemisphericus</i> and <i>Composita ficoidea</i> were obtained	15 6	398 0
Dark to medium grey, subcrystalline limestone interbedded with bands rich in porcellanous masses and with shale. The commonest fossils are <i>Chaetetes septosus</i> , <i>Carcinophyllum vaughani</i> and <i>Composita ficoidea</i> , but <i>Lithostrotion martini</i> and fragments of <i>Syringopora</i> sp. were also found	22 0	420 0

There is little new to add concerning the fossils collected from the Carboniferous Limestone except that *Spirifer ovalis* (199 feet) is recorded for the first time from the Bristol District and that *Leptaena analoga* (220 feet) is rare in the D₁ subzone.

The several stratigraphical divisions were clearly delimited in

No. 2 Borehole,* and in the table below they are correlated with the record of No. 1 Borehole and with our revised reading of the Laundry Borehole.†

						No. 1	No. 2	Laundry
						O.D. 249	O.D. 209	O.D. 270
						ft. ins.	ft. ins.	ft. ins.
Lias	..	..	..	..	..	55 0	45 0 }	78 0
Rhætic	{	Upper	..	..	..	} 13 0 }	18 0 }	25 4
		Lower	..	..	..			
Trias	{	Tea Green Marls	..	..	..	18 0	12 0	94 6
		Red Marls	..	..	..	82 6	61 3	
		Dolomitic Conglomerate	..	..	..	—	4 3	
Carboniferous	{	D ₂ subzone (lower part only)	..	..	..	125 6	—	198 0
		D ₁ subzone	..	..	..	300 0	126 10†	—
Limestone	{	S ₂ subzone (upper part only)	..	..	..	100 0	152 8	—

† Part only of the D₁ subzone.

No. 1 Borehole : longitude 2° 34' 31", latitude 51° 30' 44".

No. 2 Borehole : longitude 2° 35' 11", latitude 51° 30' 12".

Laundry Borehole : longitude 2° 34' 22", latitude 51° 30' 32".

The successions appear straightforward in all cases, with the exception of 25 feet 4 inches for the Lower Rhætic in the Laundry Borehole and this is open to doubt for it is excessive. The heights above Ordnance Datum for the Carboniferous surface are approximately the same, being 80½ feet, 68½ feet and 71½ feet for No. 1, No. 2 and Laundry Boreholes respectively (see Fig. 13). Nothing is known of the depth or slope of this surface between the site of No. 2 Borehole and Filton village to the north-east but it is probably almost level. Westwards and north-westwards of No. 2 Borehole there must be, however, a steep slope in the Carboniferous surface; 200 yards west-north-west of this borehole the Carboniferous Limestone used to crop out in the bed of the River Trym at a height a little in excess of 200 feet above sea level§ whereas in the borehole the surface is 68½ feet above sea level. The paucity of joints in the Carboniferous Limestone cores and the presence of an exceedingly coarse-grained boulder bed comprising the Dolomitic Conglomerate indicate that the difference in level is more likely to be due to erosion than faulting. The minimum angle of the slope is slightly greater than 1 in 4½, or 12½°, and it probably exceeds this figure.

Another interesting feature is that the Triassic beds are 77½ feet

* The Carboniferous Limestone showed a dip of 25° at a depth of 210 feet rising to 28° at 270 feet and then remained constant.

† Whittard and Smith, *op. cit.*, p. 447.

§ Kellaway, G. A. "The Rhætic and Liassic Rocks of Henleaze and Southmead." *Proc. Bristol Nat. Soc.*, 4th Ser., vol. vii, 1931, fig. 3.

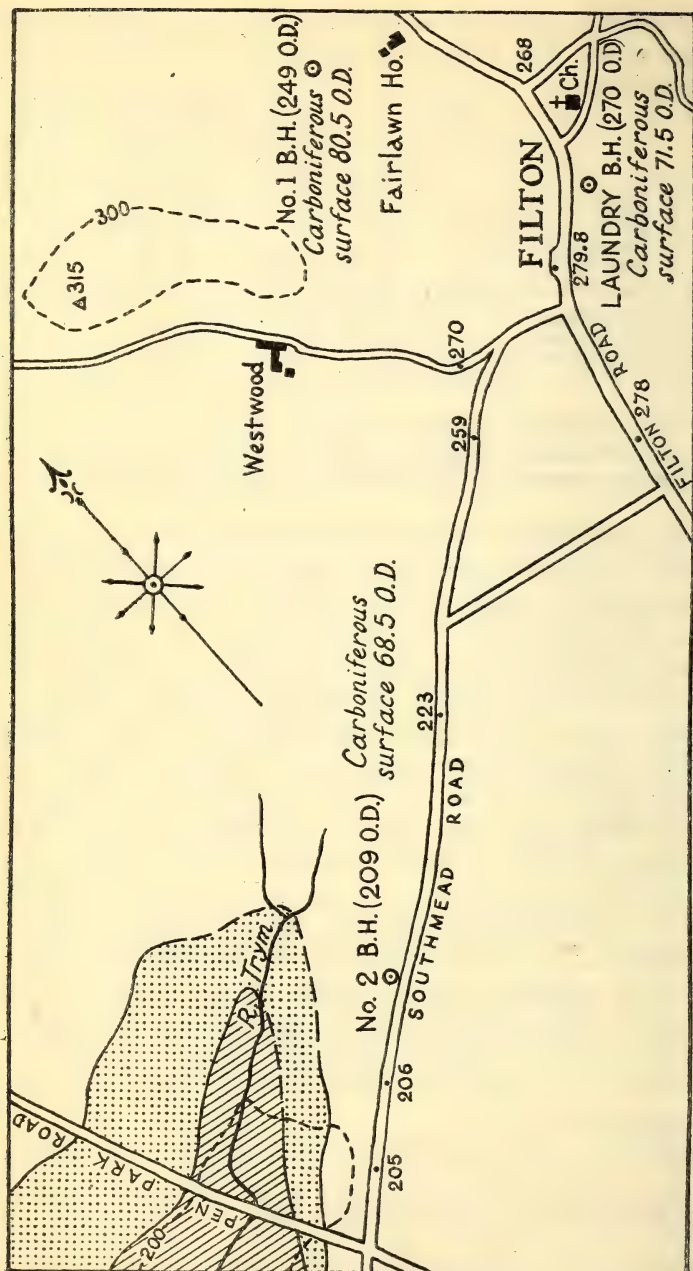


FIG. 13.

SKETCH-MAP OF THE FILTON BOREHOLES

Scale, 6 inches to 1 mile.

Jurassic: unshaded. Rhaetic: stippled. Carboniferous Limestone: line-shaded.

thick in No. 2 Borehole whereas in a distance of 200 yards in a west-north-westerly direction, they terminate against the Carboniferous surface and are overlapped by the Rhætic beds. Kellaway† has shown in a section drawn from the Gloucester Road north-westwards to Upper Knowle that in the Carboniferous Limestone there is a valley, now infilled with Mesozoic strata, which probably trends north-eastwards. The new information, which No. 2 Borehole provides, indicates that the floor of this infilled valley drops steeply north-eastwards and then flattens out in the direction of Filton.

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† Kellaway, *op. cit.*, p. 298.

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